



An. Walker delin.



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A GENERAL
TREATISE
 OF
AGRICULTURE,
 BOTH
 PHILOSOPHICAL and PRACTICAL;
 Displaying the ARTS of
Husbandry and Gardening:
 IN TWO PARTS.

PART I. OF HUSBANDRY;

Treats of the Nature of the SOIL, AIR, and SITUATION proper for the Production of VEGETABLES; the different Methods of Improving LANDS; the Manner of Planting and Raising

TIMBER; the Stocking of Farms with CATTLE, POULTRY, FISH, BEES, GRASS, GRAIN, &c. with Estimates of the Profits arising thereon, &c.

PART II. OF GARDENING;

Treats of the Circulation of the Sap in VEGETABLES; the Generation of PLANTS, and their Distribution into GENERA; the different Kinds and particular Management of FRUIT and FRUIT-TREES; the Methods of Grafting, Inarching, and Inoculating; the Dispositions of GARDENS

in General; the Cultivation and Improvement of the KITCHEN and PLEASURE GARDENS; the Manner of managing EXOTIC PLANTS and FLOWERS, and naturalizing them to our Climate; together with an Account of STOVES, ARTIFICIAL HEATS, &c.

Originally written by *R. BRADLEY*, Professor of BOTANY in the University of *Cambridge*, and F.R.S.

And now not only corrected and properly methodised, but adapted to the present Practice, and improved with the late Theories, in many large NOTES, wherein the several Methods of CULTURE, and the different Systems of BOTANY and VEGETATION, according to the most approved Writers of the present Period upon these Subjects, are delivered.

With a Compleat INDEX of all the Matters contained in the Book.
 Illustrated with TWENTY COPPER-PLATES.

L O N D O N:

Printed for W. JOHNSTON, R. BALDWIN, J. FULLER, J. WREN,
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 A. LINDELL and J. ROBINSON.

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THE GREAT

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THE ECONOMIC

Husbandry and Gardening

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P R E F A C E

BY THE

E D I T O R S.

THE importance of Agriculture to the public interest is such, that the knowledge thereof cannot be too much cultivated, nor the means of its improvement too much regarded. That this art has, within the present century, made considerable progress towards perfection, cannot be denied; the discoveries in experimental philosophy, the great parent or promoter of all useful knowledge, have with manifest success been applied in the process of vegetation, and upon the footing of various experiments different theories have been formed and put in practice.

Among all the men of genius and letters of our country, who have ever laboured for the advancement of Agriculture, not one has perhaps acquired more reputation in this way than Mr *Bradley*; and as none has treated the subject more fully in all its branches, we thought a new Edition of his *General Treatise of Husbandry and Gardening*, the

most proper to present the Public with, not only because all his writings are reducible to this *General Treatise*, but also, on account that he intended it as a summary, or system, of whatever he published upon the subject.

How far Mr *Bradley's* Theory of Husbandry, the most valuable branch of Agriculture, was consistent with the sense and experience of several persons eminent in the practice of that art, will appear from a perusal of the following Treatise. And thence also, in the course of his correspondence with Mr *Fairchild*, Mr *Whitmill*, Mr *Miller*, Mr *Ghapman*, Mr *Telende* and others, will appear the great deference paid to his judgment in Gardening by the most able and experienced practitioners.

There are several learned and ingenious pieces of our author upon the theory of vegetation, grounded upon a variety of experiments, published in the philosophical works of the Royal Society, of which he was a Fellow. The celebrated *Linnaeus* classes him among the number of eminent botanists who maintained the sexes of plants; and his great knowledge in that branch of natural history no doubt procured him the honour of being Professor of Botany in the University of *Cambridge*. It may be further added, as a proof of the importance of Mr *Bradley's* knowledge in the principles of vegetation, that all such as have attempted to overturn any part of the doctrines which he adopted, have always attacked him as

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one of the most formidable antagonists in their way; thus the Ingenious Mr *Tull* takes every opportunity of overthrowing his theory, and the Reverend and Learned Dr *Hales* examines minutely his arguments in support of his favourite doctrine the circulation of the sap, which indeed (as he informs us, Page 239) he himself first ventured to explain.

Having thus, we presume, settled our author's claim to rank among the foremost of the writers upon Agriculture, it now remains that we apologize for the freedom we have thus taken with his work, by pointing out what we have done to amend his faults, and supply his deficiencies.

A fault justly chargeable upon Mr *Bradley* was his want of method in treating his subject, which indeed he seems to have been at no further trouble to adjust than as matters occurred or were suggested to him. The original work, which was first published about thirty years ago, was thrown into four *Parts*, in each whereof the different subjects of Husbandry and Gardening were indiscriminately mingled together, and sometimes in the same chapter. This fault we so far remedied as to have ranged whatever belongs to either of the two subjects of Husbandry and Gardening in a *Part* peculiar to each subject. And wherever we judged it of use we made references from one place or chapter to another, by directions at the bottom of the page; maintaining thereby a chain of connection throughout the several parts of

of the work. But besides the advantage which the original received from the arrangement, connection, and disposition of the subjects, the stile or manner of expression has been greatly amended, which in many places was not only uncouth, but difficult to be understood.

It is a very just observation of the authors of a very late large work upon Husbandry and Gardening, "That all that is valuable in the books upon these subjects may be comprized in a small compass." Hence it is, that we have been able not only to reduce this work of Mr *Bradley*, which originally consisted of two volumes in octavo, to the compass we now offer it to the public, without suppressing any thing the knowledge whereof was of consequence to the subject; but to collect and intersperse therein, whatever we found of value relating to these subjects in other authors. Mr *Bradley* indeed afforded us the like opportunity with other writers upon the subject of abridging his work. In general he abounded with observations and reflections that related only, or were peculiar, to the times wherein he wrote, or to the persons with whom he corresponded; he interspersed these reflections with domestic occurrences, or matters of private concern. He frequently repeated the same argument, and more than once urged the same precaution, or recommended the same practice. He dealt much in conjectures, proposed hypotheses without principles, and laid down positions without deducing any inference; and finally, he indulged oftentimes
his

his own vanity, and flattered that of his correspondents, by assuming or dispensing honours that now do them no injury or discredit to be stripped of.

These, and many other the like accidents of writing, which we met with in reading the works of Mr *Bradley*, we cancelled, to make room for matters of greater moment, that were to be collected from other authors upon the subject. For this end we have consulted all the modern writers of reputation, and generally exhibited such of their sentiments as were most to our liking, upon a subject wherein we either found them different from those of Mr *Bradley*, or wherein we judged his treatment of the matter either obsolete or defective, and where their doctrines might serve as a supplement to his: this we have done sometimes by an extract, and where we thought necessary by an abstract of the systems of authors: thus have we given abstracts of *Tull's* Method of Husbandry, and *Linnaeus's* System of Botany.

Upon the whole, we hope that the choice, quantity, and variety of our additions are such, as will be found to have adapted this Edition to the present practice of Agriculture; and to have enriched it with a summary, at least so far as they regard our subject, of all the theories which deserve any notice that have appeared since the time wherein the original work was wrote.

Here

Here we once for all apprize the Reader, that as our author's precision in point of time did not render it necessary, nor indeed practicable, that we should adapt him to the New Style, which has put us eleven days forward, this difference of the Styles is to be always regarded where judged expedient, as well in the Notes as in the Text; only *Plate XIX*, with the Explanation thereof, was thought convenient to be adapted to the New Style, because there particular days are specified; another instance of such precision being perhaps not to be met with any where throughout the work.

In regard to the *Plates* we have only to observe, that besides adjusting those originally published in this work to our present purpose, we have made an addition of Three Plates more, besides an elegant Frontispiece. And finally, to give this Edition all the advantages in our power, we have annexed a copious Index or Table of Contents.



A GENERAL

A GENERAL TREATISE
OF AGRICULTURE
PART I
OF HUSBANDRY.

A General
TREATISE
OF
AGRICULTURE.
PART I.
OF HUSBANDRY.

INTRODUCTION.

THE design of this work is to enquire into the nature of such lands as are most capable of improvement, and to propose the most proper method for fertilizing them: for though our English husbandmen are allowed by all nations to have a genius in Agriculture superior to those in any other country, yet it is rare to find one among them that ever attempts any new discovery; or even can give any other reason for what he does, than that his father did the same before him (a).

The
(a) Here it may not be improper to give the reader some idea of the new method of husbandry introduced by Mr. Tull, since our author's time, and called the *Horse-hoeing Husbandry*.

The correspondence I have already fixed, and what I still expect from some of the first class in this way of study, will sufficiently (with my own remarks) furnish

Husbandry. Hoeing then, according to *Tull*, is the breaking or dividing the soil by tillage, while the corn, or other plants, are growing thereon. It differs from common tillage (which is always performed before the corn or plants are sown or planted) in the times of performing it; and is much more beneficial to the crops than any other tillage. This sort of tillage is performed various ways, and by means of different instruments. Land which, before the tilling, would have yielded little, though the more it is tilled before sowing, the more plenty of crop it yields, yet, if tilled only before the sowing, will always have some weeds, and they will partake of the advantage of the tillage as well as the corn. This is one reason for an after tillage, such as that by hoeing. But there is another consideration that yet more requires it; this is, that as soon as the ploughman has done his business, by ploughing and harrowing the land, after sowing, the soil, of its own accord, begins to undo it all again, by tending towards its original texture, and specific gravity again; the altering of which was the only business of all the former tillage. The breaking the particles of the earth, and making in it new pores, and new particles, or new superficies, is the great business of the plough and harrow; but as soon as their use is over, the earth begins to coalesce again into its own form, the particles unite together, and the artificial pores in a great measure close up. The seed is nourished in a worse ground than it was first put into, and the more the plant grows up, and requires a larger supply of food, the worse the pasture becomes. While nourishment is thus denied to the growing plants, they are at the same time choked with weeds, which being of a hardier nature than they, will grow with less supplies, and therefore thrive more vigorously, and rob them of a great part of the little food the land before allowed them.

Farmers in all ages have been acquainted, in some degree, with the use of tillage and dung to crops of useful plants, but they have so ill managed the time of giving these assistances

OF HUSBANDRY.

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furnish out such a work as I now design, and contribute to the general improvement of lands; which will not only be like a new acquisition of territories to

ances to nature, that there is no doubt but one third part of the nourishment raised by dung and tillage, if it were given to plants and corn at many proper seasons, and proportioned to the different times of their exigencies, would be of more benefit to the crop, than the whole is, when applied, as it commonly is, only at the time of sowing.

Nature, by what she does in the animal oeconomy, seems to point out to us something like the remedying this by hoeing; for when the teeth, as the plough, have tilled that soil or mass which is earth altered; and when the saliva and the juices of the stomach have served to divide and attenuate it, as the salts of dung and other manure do land; after all this, the bile and pancreatic juices are ordained to farther attenuate it, at the very time when it is ready to be exhausted by the numerous mouths of the lacteals, situated in the intestines. This last operation of these juices seems analogous to the meliorating the soil by hoeing, after the plants are grown, and are turning fit for use.

Transplanting is nearly allied in its nature to hoeing, but it is much inferior. The nature of this will not admit of its being a general thing; and even if it would, hoeing is better: for, by transplanting, the plants can only be kept up to a certain period, after which they will not bear it; but hoeing may be used to them with advantage to their utmost standing, and makes them vigorous all the while. The roots of a plant are necessarily broken off in transplanting; and it requires some time for it to strike a whole set of new ones; and if the earth about it is not kept thoroughly moistened all this time, the new formed roots will not be able to shoot, and the plant will starve in the midst of plenty: but on the contrary, in hoeing, the same advantage of a new pasture for the plant is obtained, by breaking the particles of earth; and at the same time no more of the roots are broken off than can easily be supplied, and the rest remaining in their places, the plant continues growing, without that stop and decay which must happen on transplanting, and which it

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recovers

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to our nation, and perhaps be one mean of restoring our credit, but will prove of advantage to the poor in general, by employing them in profitable and healthful exercises.

It

recovers only by degrees. It is observed, that some plants are the worse for transplanting: Lucerne and saintfoin are never so good after transplanting, as when they are left in their native places at the same distances; and finochia removed, is never so good and tender as when it is not. This last plant receives such a check from transplanting in its infancy, that it has afterwards a disease like the rickets, which causes knots and swellings in it, that spoil it as a delicacy. All the top-rooted plants suffer by transplanting, for it is necessary in this to cut off the main long root, which afterwards, however good the soil may be, never arrives at the length it otherwise would have had, and which was necessary for the success of the plant.

One great benefit of hoeing is, that it keeps plants moist in dry weather, the advantage of which to their growth is easily seen. This good office it performs on a double account: First, as they are better nourished by hoeing, they require less moisture, and consequently carry off less; for those plants which receive the greatest increase, having most terrestrial nourishment, carry off the least water, in proportion to their augment, as is proved by Mr Woodward from experiments. Thus barley or oats being sown on a piece of ground, well divided by tillage and dung, will come up and grow well without rains, when the same grains sown on another part of the same land, not thus dunged or tilled, will scarce come up at all without rains, or if they do, will wait wholly for the rains, for their growth and increase.

The hoe also, particularly the horse-hoe, for the other does not go deep enough, procures moisture for the roots from the dews, which fall most in dry weather; and these dews seem to be the most enriching of all moisture, as they contain a fine black earth, which will subside from them in standing, and which seems fine enough to be the proper pabulum, or food for plants.

A demonstration that the tilled earth receives an advantage from these dews, which the untilled does not, is this: Dig a hole

It is with no small pleasure that I observe some noblemen and gentlemen begin to enter into the reasonableness of making plantations of timber, and preserving

hole in any piece of land, of such a depth as the plough usually goes to; fill this with powdered earth, and after a day or two examine the place, and the bottom part of this earth, and bottom of the hole will be found moist; while all the rest of the ground, at the same depth, is dry. Or if a field be tilled in lands, and one land be made fine by frequent deep ploughings, while another is left rough by insufficient tillage, and the whole field be then ploughed across in the driest weather, which has continued long; every fine land will be turned up moist, and every rough land as dry as powder from top to bottom.

Although hard ground, when thoroughly soaked with rain, will continue wet longer than fine tilled land adjoining to it; yet this water serves rather to chill than to nourish the plants standing in it, and to keep out the other benefits of the atmosphere; it leaves the ground much harder also than before, when it is finally exhaled out of it; and, when at length the earth is thus hardened, it can receive no benefit from any thing less than a deluge of rain, which seldom falls till the season of vegetation is over. As fine hoed ground is not so long soaked with rain, so the dews never suffer it to become perfectly dry: this appears from the flourishing state of plants in hoed ground, whilst others near them, but in ground not hoed, are starved for want of nourishment.

The common opinion is against this, but observation proves it to be true against the common opinion. The vulgar are guided by this, however, and will not hoe their ground in dry weather, for fear of letting in the drought, as they call it, whereas hoeing this is the only method of keeping away the drought, and without either this or watering, the plants must perish in these seasons.

But the reader who would form a more accurate judgment of this new method of husbandry, must consider the principles more at large upon which this manner of culture is founded, whereby he may discern better how far the theory is consistent with nature; and these principles he shall meet with ingeniously delivered in Mr Tull's *Horse-hoeing Husbandry*.

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serving and weeding such woods as their ancestors were wise enough to plant. The plantation and care of timber is like buying the reversion of an estate; for by expending a little money, we become heirs to great sums.

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bandry: In the mean time we shall here present him with an estimate of the profits arising from the common method of husbandry, and the horse-hoeing husbandry: because the many advantages the latter has over the former, as is pretended, as well by Mr *Tull*, as by the Editors of the last edition of his book, will best appear by a fair comparison.

But in order to do this justly, there are four previous things to be carefully considered: 1. The expence of a crop. 2. The goodness of the crop. 3. The certainty of it. And, 4. The condition in which the land is left after the crop.

The profit or loss arising from land, is not to be computed only from the value of the crop it produces, but from its value after all expences of seed, tillage, &c. are deducted. Thus when an acre of land produces a crop worth four pounds, and the expences of it amount to five pounds, the loss of the farmer is one pound upon it; whereas, when as much land produces a crop only of the value of thirty shillings, and the expences are only ten shillings, the owner receives one pound advantage. The common expence of an acre of sowed wheat, in the usual way, is four pounds ten shillings, and the common expence of an acre of wheat, in the horse-hoeing husbandry, is only ten shillings, including all the expences that can attend it. Thus this method of husbandry is but a ninth part of the charge of the common way; and as no sheep are required, as there are in the other way, the less stock will do to begin with. The goodness of a crop consists in the quality of it as well as in the quantity, and wheat being the most useful of all grain, a crop of this is more valuable than a crop of any other corn. Add to this, that a crop of hoed wheat has always larger ears, and a fuller body, than a crop when sown in the common way. More wheat may also be obtained this way than any other, because the same land will thus produce crops every year; and even the

The planting of timber therefore, which carries so much advantage with it, I shall propagate as much as possible in this work ; having several observations and

the land which has been exhausted by the common husbandry, will produce wheat in plenty this way, without fallowing or dunging, both which would otherwise be necessary. So that, in many places, this husbandry can raise ten acres of wheat for one that the old way could produce, because where land is poor, they sow but a tenth part of it in wheat.

The largest produce of an acre of wheat land, so far as has yet been experienced, seems to be ten quarters, or eighty bushels to an acre. This is less indeed than the produce of an acre in the common way, according to *Houghton's* computation ; but to compare the different profits to the farmer, we proceed thus : The rent and expences of a drilled acre being one pound, and that of a sowed acre in the common way being five pounds, one quarter of corn produced by the drilled, bears an equal proportion to one pound in profit, as five quarters produced in the common way do to five pounds. As suppose it to be of wheat at two shillings and sixpence a bushel, there is neither gain or loss in the one nor the other acre, though the drilled produced only one quarter, and the other five quarters.

But if the drilled acre yield two quarters, and the sown acre yields only four quarters at the same price, the drilled acre brings the farmer one pound profit, while the other has one pound loss. Likewise suppose the drilling farmer to have his five pounds laid out in five acres of wheat, and the other to have his five pounds laid out in one dunged acre, then let the price be what it will for the wheat, if the five acres have an equal crop to the one acre, the gain and loss must be equal. But if the price of wheat be at two shillings and sixpence, the farmer in the common way, if he have five quarters on his acre, must sell it all to pay his rent ; whereas if he who drills the land have five quarters on each acre, the produce of one acre will pay for all the five. Or suppose a drilled acre to produce no more than one third of the sown acre, which is rating it very low indeed, the expence of the sown acre being five times as much as that of the drilled one,

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and letters now by me of importance, which relate to the subject; wherein there are not only many discoveries tending to the improvement of woods and timber-

it is much more profitable to the owner to have the drilled acre; because a third part of five pounds is one pound thirteen shillings and four pence, and a fifth of the rent and expence, which is all his charge, being only one pound, such a drilled acre brings the owner thirteen and four pence profit more than the sown acre, though that brings three times as great a crop.

The certainty of a crop is greater this way than in the old way of sowing; for most of the accidents attending wheat crops, are owing to their being late sown, which is necessary to the farmer in the old way; but in the horse-hoeing method the farmer may plough two furrows whereon the next crop is to stand, immediately after the first crop is off. In this manner of husbandry the land may be ploughed dry and drilled wet, without any inconvenience; and the seed is never planted under the furrow, but placed just at the depth which is most proper, that is at about two inches, in which case it is easy to preserve it, and there is no danger of burying it. Thus the seed has all the advantage of early sowing, and none of the disadvantages that may attend it in the other way, and the crop is much more certain than by any other means that can be used.

The condition in which the land is left after the crop, is no less in favour of the horse-hoeing husbandry, than all the other articles. The number of plants is the great principle of the exhausting of land. In the common husbandry, the number is vastly greater than in the drilling way, and three plants in four often come to nothing, after having exhausted the ground as much as profitable plants; and the weeds, which live to the time of harvest in the common way, exhaust the land no less than so many plants of corn, often much more. The horse-hoeing method destroys all the weeds in the far greater part of the land, and leaves that part unexhausted and perfectly fresh for another crop. The wheat plants being also but a third part of the number at the utmost of those in the sowing way, the land is so much the less exhausted

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timber-plantations, but an account of the value of timber-trees, whereby we may compute the increase of worth in such trees from one to twenty years: whence

haulted by them; and it is very evident from the whole, that it must be, as experience proves that it is, left in a much better condition after this than after the common husbandry.

The farmers who are against this method, object that it makes the plants too strong, and that they are more liable to the blacks, or blights of insects for that reason; but as this allows that the hoeing can, without the use of dung, give too much nourishment, it is very plain that it can give enough; and it is the farmer's fault if he does not proportion his pains so as to have the advantage of the nourishment without the disadvantages. It is also objected, that as hoeing can make poor land rich enough to bear good crops of wheat, it may make good land too rich for it. But if this should happen, the sowing of wheat on it may be let alone a while, and in the place of it the farmer may have a crop of turneps, carrots, cabbages, and the like, which are excellent food for cattle, and cannot be over-nourished: Or if this is not chosen, the land, when thus made too rich, may soon be sufficiently impoverished by sowing corn upon it in the common old way.

This being premised, we shall now observe that, in the preface of the editors to the last edition of *Tull's Horse-hoeing Husbandry*, we are assured, that though the method of culture proposed by that ingenious author has made but little progress in *England*, it is not likely to meet with the same neglect abroad, especially in *France*, where *M. Du Hamel* published a treatise on tillage, on the principles of *Mr Tull*, where he has drawn a comparison between the old method of husbandry and the new, by which calculation the profits arising from the new, are considerably more than double those of the old. For according to him, the profits of twenty acres of land for ten years amount, at $10\frac{1}{2}d.$ pp Livre,

	Livres.	£	s.	d.
By the old method, to	3000	or 131	: 5	: —
By the new method, to	7650	or 334	: 13	: 9

which makes a prodigious difference in favour of the latter.

But

whence we may come near a certainty of the growth and value of timber, and acquaint the public how much every acre of wood-plantation may grow in a day, a week, a month, or a year, having due regard, at the same time, to the sorts which are growing, according to their proportion of difference in that respect.

But then they give us a computation of the expence and profit both of the old method of culture and the new, which they affirm was experimentally tried by a gentleman of veracity, in a country where the soil was light and chalky, that is, of the same nature with that from whence Mr *Tull* drew his observations. In the new husbandry every article is said to be put at its full value, and the crop of each year is four bushels short of the other, though in several years experience it has equalled and generally exceeded those of the neighbourhood in the old way.

I. In the old way.

First ploughing, at 6s. $\frac{1}{2}$ acre,	£ 3	—	—	—
Second and third ditto, at 8s. $\frac{1}{2}$ acre,	—	—	—	—
Manure, 30s. $\frac{1}{2}$ acre.	—	15	—	—
			£	s.
			22	—
Two harrowings, and sowing, at 2s. 6d. $\frac{1}{2}$ acre,	—	—	£ 1	5
Seed, 3 bushels $\frac{1}{2}$ acre, at 4s. $\frac{1}{2}$ bushel,	—	—	—	—
Weeding, at 2s. $\frac{1}{2}$ acre,	—	1	—	—
Reaping, binding, and carrying, at 6s. $\frac{1}{2}$ acre,	—	—	3	—
			11	5
			33	5
				Second

not only the making of plantations, or the tilling or sowing of land with proper crops of plants, or grain, which enriches an estate: There is also great profit to be reaped by grazing and feeding cattle and poultry; and without they are rightly understood, a farmer may lose a great part of those benefits which the judicious husbandmen enjoy. Nor indeed is the knowledge of pond-fish, and the method of improving

Brought over	£	33	: 5	: —
Second year, for barley, costs	11	l. 6	s. 8	d. viz.
One ploughing, at 6s. per acre,	£	3	: —	: —
Harrowing and sowing, at 1s. 6d.				
per acre,	—	—	—	0 : 15 : —
Seed, 4 bushels per acre, at 2s.				
per bushel,	—	—	—	4 : — : —
Weeding, at 1s. per acre,	—	—	—	0 : 10 : —
Cutting, raking, and carrying, at				
3s. 2d. per acre,	—	—	—	1 : 11 : 8
Grass seeds, at 3s. per acre,	—	—	—	1 : 10 : —
				<u>£ 44 : 11 : 8</u>

Third and fourth year, lying in grass, cost nothing, so that the expence of ten acres in four years comes to 44*l.* 11*s.* 8*d.*

And in twenty years to	—	—	—	£ 222 : 18 : 4
First year's produce is half a load of wheat				
per acre, at 7 <i>l.</i>	—	—	—	35 : — : —
Second year's produce is two quarters of barley				
per acre, at 1 <i>l.</i>	—	—	—	20 : — : —
Third and fourth year's grass is valued at 1 <i>l.</i>				
10 <i>s.</i> per acre,	—	—	—	15 : — : —

So that the produce of 10 acres in 4 years is 70 : — : —

And in twenty years it will be	—	—	—	350 : — : —
Deduct the expences	—	—	—	222 : 18 : 4
And there remains clear profit on ten acres in				
twenty years by the old way,	—	—	—	£ 127 : 1 : 8

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ing them, to be neglected: These carry their value with them; even though such ponds lie near the sea, I have often heard gentlemen regret the want of such conveniencies; There

II. In the new way.

First year's extraordinary expence is, for ploughing and manuring the land, as in

the old way, — — — — — £ 22 : — : —

Ploughing once more, at 4s. $\frac{1}{2}$

acre, — — — — — £ 2 : — : —

Seed, nine gallons $\frac{1}{2}$ acre, at 4s.

$\frac{1}{2}$ bushel, — — — — — 2 : 5 : —

Drilling, at 7d. $\frac{1}{2}$ acre, — 0 : 5 : 10

Hand-hoeing and weeding, at

2s. 6d. $\frac{1}{2}$ acre, — — 1 : 5 : —

Horse-hoeing six times, at 10d.

$\frac{1}{2}$ acre, — — — — — 5 : — : —

Reaping, binding, and carrying,

at 6s. $\frac{1}{2}$ acre, — — — 3 : — : —

The standing annual charges — — — — —

on ten acres is — — — £ 13 : 15 : 10

— — — — —

Therefore the expence on ten acres for twenty

years is — — — — — £ 275 : 16 : 8

Add the extraordinaries of the first year, the

Sum is : — — — — — 297 : 16 : 8

The yearly produce is at least two quarters

of wheat $\frac{1}{2}$ acre, at 1l. 8s. $\frac{1}{2}$ quarter,

which on ten acres in 20 years amounts to 560 : — : —

Therefore, all things paid, there remains

clear profit on ten acres in twenty years, by

the new way, — — — — — £ 262 : 3 : 4

So that the profit on ten acres of land in twenty years in the

new way exceeds that in the old way by 135l. 1s. 8d. and

consequently is considerably more than double thereof; an

ample encouragement to practise a scheme whereby so great

advantage will arise, from so small a quantity of land, in

the compass of a twenty one year's lease, one year being

allowed, both in the old and new way, for preparing the

ground.

There is one thing more which requires our observation, and demands our study, relating to the use of water, where the ground about it is upon a flat; if the water in this case happens to be under government, so as to be confined within proper bounds, it will turn to extraordinary advantage to the proprietor.

How necessary it is to consider the proper soil, air and situation, in every thing we undertake in Husbandry and Gardening is very well set forth in the following letter.

To Mr BRADLEY, F. R. S.

S I R,

AS we often had opportunities of conversing about the difference of soils, and the temperature of air required for the production and nourishment of vegetables, I here send you, as near as I can remember, the sum of our arguments, with some remarks which I have made upon them.

To begin then. You seem to be of opinion that it was not the soil or earth itself which afforded sufficient provision for the several plants or vegetables; but that there were residing in every earth, some agreeable juices to nourish plants of different kinds; and as those juices were more or less abundant in that earth, or had different qualities, so the vegetables planted in it would be more or less vigorous: These juices, or salts, you supposed were furnished by the air, and put in action by the sun; to prove which you referred me to the following experiment, said to be *Helmont's*, related by Mr *Boyle*: he dried two hundred pounds of earth, and planted a willow of five pounds weight in it, which he watered with rain, or distilled water; and to secure it from any other earth

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earth getting in, he covered it with a perforated tin-cover. Five years after, weighing the tree, with all the leaves it had borne in that time, he found it to weigh one hundred and sixty-nine pounds, three ounces; but the earth was only diminished about two ounces in its weight (b). This experiment I found, as you directed, in Mr *Derham's Physico-Theology*. I have made some others of the same kind, and find that the plant has little more use of the earth it stands

(b) Mr *Bradley* being the chief, if not the only author who has published this phantasy, which at present seems to get ground, it is fit he should be answered.

The tin-cover was to prevent any earth from getting in; this must also prevent any earth getting out, except what entered the roots, and by them passed into the tree. A willow is a very thirsty tree, and must have drank in five years time several tuns of water, which must necessarily carry in its interstices a great quantity of earth, probably many times more than the tree's weight, which could not get out, but by the roots of the willow: therefore the two hundred pounds of earth not being increased, proves that so much earth as was poured in by the water did enter the tree. Whether the earth did enter to nourish the tree, or whether only in order to pass through it (by way of vehicle to the air) and leave the air behind for the augment of the willow, may appear by examining the matter of which the tree did consist. If the matter remaining after the corruption or putrefaction of the tree be earth, will it not be a proof that the earth remained in it to nourish and augment it? for it could not leave what it did not first take, nor be augmented by what passed thro' it. According to *Aristotle's* doctrine, and Mr *Bradley's* too, "Putrefaction resolves it again into earth, its first principle." The weight of the tree when green must consist of earth and water; air could be no part of it, because air being of no greater specific gravity than the incumbent atmosphere, could not be of any weight in it, therefore was no part of the one hundred and sixty nine pounds, three ounces. *Tull.*

stands in, than the keeping it fixed and steady (c); but then, as earths are more or less binding, the salts or juices proper for vegetation have more or less liberty to act. From experiments of this kind one might come to a reasonable judgment how much a tree increases in every year of its growth, and how much it improves in value; but I shall leave that to be considered more particularly by yourself, and shall only offer this hint, that the earth, after the tree is drawn from it, must be weighed in the same state it was in when the tree was planted in it: The fairest way, I think, is to make it as dry as possible in an oven, at both times. This would lead us into many curious speculations, and induce us to think that the fine body of the air becomes dense as water in the vessels of the tree, and from that state become fixed, and solid as the wood of the tree. I think it is almost demonstrable, that the vegetable nourishment is principally in the air, from the foregoing experiment; the two ounces of earth lost, might perhaps remain on the sides of the case the tree was planted in, or upon its roots; or in the weight of two hundred pounds I think two ounces might easily be lost, unless both the scales and the weigher are very exact; and indeed in the baking or drying of the earth, there might be two ounces more of moisture found in that quantity of earth, at one time than another.

Thus supposing it to be the air which feeds and nourishes plants, and from the instance you have given me of the tree sedum, which will take root, and live without earth and water for several years; I am led to consider how much the different changes and

(c) If, as Mr *Bradley* and other authors say, the earth is of little more use to plants than to keep them fixed and steady, there would be little or no difference in the value of rich and poor lands, dunged or undunged; for one would serve to keep plants fixed and steady, very near, if not quite, as well as the other. *Tull.*

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and alterations of air work upon vegetables. The example of a piece of the sedum arborescens, hung up at Mr Fairchild's at Hoxton, which you say shoots out its roots when the air thickens and tends to rain, I have so far experienced, that I am persuaded it is constantly so; and I have tried other sedums, which proportionally do the same; but it is difficult to determine whether the different quantity of moisture contained in each of the kinds of them, may not, upon one certain temperature of air, be disposed to exert itself to the utmost of its power in each respective plant; or whether, according to the different textures of the several plants, every one is not impowered in its own way to receive a certain impulse, or distinct nourishing quality from the air, which the rest cannot equally share of. In one conversation which I have had with you, I remember you was of opinion, that the vessels of each distinct plant were different from those in others; and that those vessels were in every plant capable of filtering the juices they received from the air or earth, in such a manner as to alter their parts, and vary their first powers: To enforce this doctrine you observed; first, that it was possible to make plants live in almost any air or soil, provided the air itself was not too much pent up or stagnated; from whence I suppose that all bodies of earth are more or less capable of imbibing the fluent air, and of attracting such salts as either the air can give, or the earth is capable of receiving; when these salts (however they come into the earth) are lodged in a body, the different strainers or vessels of the several plants growing upon that spot of earth, thus impregnated with salts, alter those salts and juices according to the several figures or dimensions of their strainers; so that one plant varies in taste and smell from others, though all draw their nourishment from the same stock lodged in the earth.

earth (d). But I remember you remarked farther, that earths themselves being of different kinds, some sorts could not take in so many of the nourishing parts of the air as others, and therefore the same sort of plant could not grow in every soil with the like vigour; that is, every sort of earth has not the same fund of salts; or else every earth is not equally capable of distributing to the plants growing in it the salts it contains, with the same freedom. Again, your instance that thyme and other aromatics, being planted near an apricot-tree, would destroy that tree, helps to confirm that every plant does not draw exactly the same share of nourishment (e). *Virgil* in his *Georgics*, gives us good hints of the different soils and situations necessary for plants of different kinds;

Nec verò terræ ferre omnes omnia possunt :

Fluminibus salices, crassisque paludibus alni

Nascuntur; steriles saxosis montibus orni;

Littorâ myrtelis latissima : denique apertos

Bacchus

(d) See Mr *Bradley's* palate of plants, and the insipid substance he allots them to distinguish the taste of, how they agree. They must, it seems, within their own bodies give the flavour to this insipid substance before their palates can be of any use, but in the manner of the dog returning to his vomit. See *Tull's Husbandry*, p. 224.

(e) But this his instance proves, that those aromatics robbed the apricot-tree of so much of its share as to starve it; and that they, though of a very different nature, did draw from the earth the same nourishment which the apricot-tree should have taken for its support, had not the aromatics been too hard for it in drawing it off for their own maintenance; unless he believes that all the juices of the aromatics were as poison to the apricot, and that some of their roots might discharge some kind of moisture in dry weather given them by others that had it for their use; and that the apricot-roots, mingling with them, might imbibe enough of that liquor altered sufficiently by their vessels, to poison and kill the tree.

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Bacchus amat colles : Aquilonem & frigora taxi.

Aspice & extremis domitum cultoribus orbem,

Eoasque domos Arabum, pictosque Gelonos :

Divisæ arboribus patriæ — Georg. 2. ver. 109 (f).

and will have it that earths of several kinds will imbibe certain qualities from the air: Mr Boyle assures us, that the earth or ore of alum, being robbed of its salt, will in course of time recover it, by being exposed to the air; which intimates something more than I have observed before; that every distinct sort of earth has even a power of its own, of extracting from the air salts of particular qualities, or else of altering the common salts of the air, according as its parts are differently framed or ordered (g).

The

(f) Nor every plant on every soil will grow;
 The fallow loves the wat'ry ground and low.
 The marshes alders; nature seems t' ordain
 The rocky cliff for the wild ash's reign:
 The baleful yew to northern blasts assigns;
 To shores the myrtles, and to mounts the vines.
 Regard the extremest cultivated coast,
 From hot *Arabia* to the *Scythian* frost:
 All sorts of trees their several countries know.

Dryden.

(g) Nothing is more difficult than to say what is the nature of the nutritive juice of plants. No question has been more debated by philosophers, and none with less success. It would be natural to think that this might be discovered by the nature of the several substances we use as manures; but in respect of these we see the effect only: this is very plain and obvious, but nothing is more hidden or difficult to find than the cause. *Complete Body of Husbandry.*

Hence we have reason to think that Mr Tull's system, however fanciful he may think that of our author, is far from being ascertained; and that in disproving Mr Bradley's doctrine, which the generality of writers have adopted, he has
 not

The other remarks which I have made in this way, I shall take another opportunity of communicating; and am, Sir, Yours, &c.

B. S.

That

not established his own: but that the reader may the better judge of his arguments, we shall here present him with an abstract of them.

There are five things generally allowed to contribute to the growth and increase of plants; these are nitre, water, air, fire and earth; but it has been much disputed which of all these it is that increases, or is properly the food of the plant. Many people say much of the acid spirit residing in the air, but as this is sharp enough to corrode iron-bars, it is too sharp to be fit for nourishing tender plants. As to nitre, it is said to nourish them; but its true office is not actually nourishing, but preparing other things to nourish them. Nitre applied to the root of a plant will kill it; but at a distance, so attenuates, cuts and divides the viscous matters found in the earth, that after this they are fit to nourish plants, though they were not so before. Water has been thought by some the only food of plants, but *Van Helmont's* famous experiment, usually brought to prove this, is nothing: for the water contains earth, and therefore is never given to a plant as water alone.

Air, because of its elasticity, is necessary to the increase of plants, but it is not that increase; though *Bradley* and others have taken great pains to prove, that it is so. As to fire, we are very well assured indeed, that no plant can live without heat; but though different degrees of it, are necessary to different plants, yet none can live in actual fire, nor has fire ever been thought the food of plants, except by Mr *Lawrence*, and some of the metaphysicians. This author indeed, says, plants are true fire-eaters; and others explain away the meaning of the phrase, by defining that fire to be only the minute particles of earth put in motion; if this be the case, probably enough the doctrine may be true. But in plain fact, earth alone is the true food and matter of the increase of plants. Every plant is earth, and the growth and increase of that plant, is only the addition of more earth to it, in the same form. Nitre and other salts, as those of dung, &c. prepare, attenuate,

That I may omit nothing which may tend to the pleasure and profit of the husbandman, or those curious persons that admire a country-life, I shall take occasion to mention how far the good management of bees may contribute to their master's advantage, after giving some account of the oeconomy of those wise labourers; for I think the profit of their wax and honey, though it is very considerable, does not carry its full value with it, if we disregard the virtue, diligence, and contrivance of the bees, who work it for us; which we may observe with great pleasure, by means of the glass or box-hives, which are so ordered that the honey may be taken without destroying the bees: but whether it is for the master's advantage to leave them alive, when they are robbed of their honey, or the greatest part of it, is yet a doubt; for it is a query whether the same bees work two summers, or even live so long; if not, the food they destroy in the

nuate, and divide the earth, destined for the increase of vegetables; water and air move it by conveying, and fermenting it in the juices; but earth itself still is the food. When the additional earth is once assimilated to the plant, it becomes a part of it, and remains for ever with it; but let water, air and heat, be taken away, and the plant remains a plant still, though a dead one.

The excess of the other things, proves, that they are not the proper food of the plant, by destroying not nourishing it. Too much nitre or other salts corrode and kill the plant, too much water drowns it, too much air dries the roots of it, too much heat burns it: but too much earth a plant never can have, unless wholly buried under it, so as to exclude the necessary action of the rest of the assistant articles. Too much or too fine earth can never be given to the roots of a plant, for they never take up so much of it, as to surfeit the plant, unless it be deprived of leaves which should purify it. Nay earth is so surely and so essentially the food of all plants, that with the proper share of the other accessory elements, any earth, no matter of what kind, will serve for the nourishment of any plant.

the winter is so much loss: however, I have been told that a swarm of bees accidentally fixed a colony in a large wine-cask, which had been carelessly set in the corner of a garden, and continued to work in it till it was quite filled with honey and wax; but I suppose the great space in the hogthead kept them from swarming, which would be a means of their increasing greatly in number, though all the bees of a year old were to die.

CHAP. I. *Experiments and observations concerning the measure and improvement of land, wherein are several particular cases stated, relating to heath-grounds, with various methods prescribed for rendering such ground beneficial.*

IN the foregoing Introduction I have mentioned some observations concerning soil and air, which ought to be considered by the husbandman and gardener, before they attempt any thing material in the practice of their several arts. I shall now give some examples of lands which have been esteemed barren, with the proper methods of enriching them, and rendering them profitable to mankind.

The first example relates to heath-ground and its improvement, wherein is explained the difference of value in the measure of hills and levels. The following letter gives us a state of the land when it bore nothing but heath.

To Mr R. BRADLEY, &c.

SIR,

I am now about purchasing five or six hundred acres of land in *Surry*, which the neighbouring people tell me has borne nothing but heath in the

memory of man; and since Mr — tells me that you think it capable of improvement: you will oblige me if you give your thoughts of it as soon as possible. I am,

Yours,

R. S.

P. S. I send you by the bearer some specimens of the earths, as they lie in their beds; N^o I, is the surface, II the next, and so on.

Account of the earths.

N^o I, A black sandy soil, which for four inches is mixed with roots of heath; the same bed of soil (but without roots) is sixteen inches deep on the hills, and in the lower lands about two feet: in this we frequently find stones resembling rusty iron.

N^o II, or second stratum, is white sand, three feet thick on the hills, and is the same in quality and thickness in the vale or low ground.

N^o III, or third stratum, a vein of gravelly soil, six inches deep on the hills—but in the vale, a grey sand fourteen inches deep.

N^o IV, or fourth stratum, a grey sand, two feet deep on the hills, somewhat wet and springy; but in the vale two feet four inches marle.

Since I received this letter, I had an opportunity of viewing the land; but as the gentleman was not then in the country, I sent him my opinion in the following epistle.

To Mr R. S. &c.

S I R,

I have carefully considered the ground you are about to purchase, which the country-people believe cannot be made profitable by any means: for my own part, was I to make a purchase of land, I would
much





Fig. I



Fig. II



Pine Sculp.



much rather chose it of this sort, than an estate which has been already improved and strained to an high rent; though it is very certain there must be some money laid out upon such land as this, before it can become profitable: but that may be done by degrees, and a man has the satisfaction at the same time to set an example to his neighbours, which may be a public benefit.

But before I enter upon the nature of the soil, and the method of improving it, it is necessary that I give you some hints concerning the measuring of such lands as are hilly or mountainous, as many of them are in the estate you mention; for their valuable contents, whether we plant, sow, or build upon them, are very different from what are found in flat or plain ground; and to convince you of this, I shall give you some few examples.

Ex. I. A hill (I suppose) may contain four equal sides, which meet in a point at the top; but the contents of those four sides can produce no more, either of grain or trees, than the plain ground upon which the hill stands, or has its base; and yet by the measure of the sides, we find twice the number of acres, roods, and poles, that are in the base, or ground-plot.

Let *Fig. I. Plate I.* be an equilateral triangle, or a body of three equal sides: from A to B, is one hundred yards; from A to C, one hundred yards; and from C to B, one hundred yards; so that from B by A to C, measures twice as much as from C to B, and therefore it is commonly supposed will produce double the quantity of grain more than the line C B: but as long as all plants preserve their upright method of growth, we may be assured such hilly ground can bear no more plants in number than the plan at the base, as we may see in (*ibid.*) *Fig. II.* which represents a hill with a row of trees planted the length of the base, at certain distances from A to C. In that figure we may observe the same number only of trees

C 4

planted

planted from A by B to C, although the line over the hill meafures almoft double the line from A to C.

Ibid. Fig. III. gives an example of buildings upon a hill; fhewing, that the two fides of the hill will only bear the fame number of houfes that may ftand in the line at the bafe (a).

Ibid.

(a) This is foreign to the queftion of how much grain, or how many trees, the hill will produce; for vegetables being fed by the earth, require much more of its furface to nourifh them than is neceffary for them to ftand on: but buildings require no more of the furface but room to ftand on: therefore no fuch argument taken from buildings can be applied to vegetables. This argument of Mr *Bradley* gives no more fatisfaction to the queftion about producing of vegetables, than a grazier would do, being asked, how many oxen a certain pafture-ground would maintain, if he fhould answer, by fatisfying you with the number of churches which might ftand thereon.

The like answer, in effect, may be given to the argument in Fig. IV. of the pales; only he has forgot to fhew, that to mound over the hill would require double the rails or double the hedge-wood (except ftakes) as to mound the bafe: if it did not, the hill would yet be of the more value, becaufe thereon more furface might be fenced in at lefs expence.

In his Fig. II. he gives no good reason why the hill fhould not bear twice the number of trees as the bafe can do, for there is as much room for two hundred trees on the hill, as for one hundred on the bafe, becaufe he allows the furface to be double to that of the bafe. He ought to meafure the diftances of the trees on the hill, by a line parallel to the furface they grow on, as well as he does the diftances of thofe below. And fuppofe the row at the bafe, together with the furface they grow on, were raifed up fo that it fhould become parallel to half the row on the hill, would not the trees on the bafe-row be twice as near to one another as the trees on the hill-row are? and fuppofe a line had been tied from the tops of all the lower trees before the row was fo raifed up at one end, and then after the fituation of the row was fo altered, if by this line the trees fhould be pulled from being perpendicular to the furface they grow on, and

made

Ibid. Fig. IV, is an example of rails, or park-paling, over a hill; whereby we may discover that though the measure be near double, by the way over the hill, of the line at the bottom, yet the same number of pales, of the same breadth, and at the same distance, serves to inclose both.

I could yet give many more examples to prove that though hills measure twice as much as the plain ground they stand upon, yet the produce of one can be no more than the other; and therefore in the purchasing of land the hills ought not to be sold or let for more than half their superficial measure, *i. e.* two acres upon the side of the hills, to pay as much as one acre upon the plain, provided the soil of both is equally rich,

made to stand oblique to that, and perpendicular to the horizon, as the upper trees are, would the distances of the trees from one another be altered by this change of posture? no, for their bottoms would be at the same distance, because not removed; and their tops because the same line holds them at the same distance in both postures.

Mr *Bradley's* lines drawn from the trees below, which are one perch asunder, make the two rows of trees falsely seem to be at equal distances, because these lines are parallel to each other. But this is a deceit, for in truth, the distances of the trees are not measured by the distances of those lines, but by the extreme points at the ends of the lines; and those two points above, where the lines cut the row obliquely, and at unequal angles, are twice as far asunder as the endmost or extreme points below are, where the lines cut the row at right angles. Hence may be inferred, that there is room for twice as many trees to grow on the hill as on the base, and twice as much grain for the same reason, because there is twice the surface for the roots to spread in; and since Mr *Bradley* allows the hill to contain two perches to one of the base, and the soil of both to be of equal goodness; and yet affirms that the two can produce no more of grain or trees than the one perch can: I cannot see why it should not be as reasonable to say, that two quarters of oats will maintain an horse no longer nor better than one quarter of oats of equal goodness will do, *Tull*,

rich, as it is supposed in this case; though generally the hilly ground is thought to be more inclining to barrenness than lower grounds.

But it remains that I say something concerning the perpendicular growth of the stems of trees, and other plants, as it is necessary to clear some doubts which may arise from the foregoing observations, among those especially who are not very well acquainted with the manner of vegetative growth.

The point of the stem, or leader of every trunk of a tree, seeks the air; and therefore in woods where the trees are thick set, the whole expence of sap follows that upright intention of nature; and the trees in such a station grow much taller and more upright, than where one single tree can have the benefit of making collateral branches.

It is necessary that every tree should grow upright or perpendicular to the horizon, for the more easy support of itself; for were trees to incline naturally more to one point than another, the winds would more readily overset them; and where trees are fully furnished in the crown or head with collateral branches, their weight will contribute by degrees to draw the roots on one side out of the ground; but especially when such branches are loaded with fruit, we frequently find the necessity of propping them, as may be observed in many orchards. We may indeed remark, that almost every stem and every root is first formed in a bending manner under ground, and yet all these stems become strait and upright when they get above ground, and meet the air; and most roots when they gather strength, run as directly downward, and shun the air as much as possible.

As proofs of this intention in nature, for the upright growth of plants, we may observe, that some (which make their first shoots horizontally from a wall, or the side of a steep bank) turn up their points or extreme branches into the air, as soon as they have taken

fast

fast hold with their roots. The *marricaria*, *parietaria*, and *antirrhinum*, are so many examples. At first indeed, when their stems are tender, their own weight bends them towards the earth; but in time, as they become stronger, although the weight of the heads of those plants is then much greater, they turn their shoots upwards, and at length grow upright almost parallel with the wall.

We may further remark how much this intention of nature is evidenced in the growth of pease, cucumbers, and such like plants; as soon as they meet the air they grow erect, till they attain the height of six or eight inches; and then, wanting strength to support their upright directions, recline, and by gentle degrees reach the ground; but nature in this case gives them means of support, to continue their perpendicular vegetation by claspers or tendrils; and if they have the opportunity of catching hold of any tree or pole near them, they will then proceed in the first rules of natural growth. But it is not worth while to give this assistance to every pea we set, we have experiments enough in every field, of their innate design of pointing their branches upwards, when they have rested themselves upon the earth sufficiently to support this second attempt.

The cucumber I find brings much fairer fruit if it has the advantage of climbing; and this plant is not unworthy such help; for if it is treated in that manner, it is grateful enough to reward our care with a valuable crop.

There is yet one more observation which I think may be necessary to support my argument, and is what I find constant in all trees that have suffered by rude winds, or have been blown down. *Monf. Dodart*, of the Royal Academy of Sciences at *Paris*, tells us, that one day coming from *Meudon*, the Dauphin's palace, through the park to *Chaville*, he observed on the descent of the hill several young pine-trees, which had

had been blown down by storms at different places; he remarked, that though the fall of those trees were very different with regard to the descent of the hill, yet the extreme branches (which had been the leaders of the stems when the trees were growing) retook their natural perpendicular growth, and turned upwards in such a manner as to form sharp angles, which opened more or less, as the fallen stems on the several descents of the hill directed them to be upright: And he observes likewise, that even the collateral branches of trees partake so far of the first purpose of the mother-stem, that whenever they are incommoded in their first design of growth, they tend upwards. But this last observation of Monsieur *Dodart* I have not been able to make.

From these remarks you may observe, that hills in their measure contain only as much profitable land as the plan or plat of ground they stand upon: and as a proof of that,

All vegetables or plants have an erect method of growth (*b*).

As

(*b*) This proof of Mr *Bradley* is founded upon an argument which has no consequence, unless it were first proved, that the surface of the earth could produce and maintain as many vegetables or plants as could stand thereon in an erect posture; which supposition is as impossible, as that half an acre could produce and maintain an hecatomb, without Mr *Bradley's* teaching oxen to live upon air for their food, as he thinks *Van Helmont's* tree did.

All expert husbandmen must needs be convinced, that the greatest crop of vegetables that ever grew might stand in an erect posture upon a twentieth, and I may say the hundredth, part of the surface that produced it: therefore there must be nineteen parts for the roots to spread, unoccupied by the trunks, stems, or stalks. And though it be true that an hill will support no more of these than its base, when placed in an erect posture, close together as in a sheaf; yet this close position is only proper for them when they are dead, and require

As to the other part of your letter, which relates to the improvement of heath-land; the remarks I have made on the several beds of earth, and the specimens you sent me of them, has given occasion to some thoughts, which I hope may be of service to you in husbandry.

In the first place, it is necessary to make the proper distinctions between the hill and the low grounds; for the vale has not only the advantage in measure, as I have already mentioned above, but has also the benefit of shelter, by means of the hills about it.

The curious Mr *Lawrence*, to whom we have been obliged for some very instructive pieces relating to gardening,

require no more nourishment than houses and pales do, and consequently, require no more room but to stand on. Therefore this argument of Mr *Bradley* must not be admitted in vegetative growth, where there is always required nineteen times more room in the surface for the use of roots than what the stems, trunks, or stalks do possess upon it: and the more room there is for the roots, the greater number of plants may be produced. Neither can I admit that all vegetables or plants have an erect method of growth: because the contrary is seen in chamomile and divers other vegetables, which have an horizontal method of growth.

From what has been said, we may conclude, that Mr *Bradley's* hill may produce more vegetables than the base whereon it stands; and therefore it is of more value than half its superficial measure, *i. e.* two acres on the hill are worth more than one acre on the plain, the soil being equally rich as he allows it to be in this case. *Tull.*

I perceive that those authors who explain vegetation, by saying the earth imbibes certain qualities from the air; and, by specific qualities, and the like, do also lay a great stress upon the perpendicular growth of vegetables, seeming to fancy there is little else necessary to a good crop but room. Mr *Bradley*, in his arguments concerning the value of a hill, does implicitly say as much. But if they would but consider the diameters of the stems, with the measure of the surface of an acre, they would be convinced that many, even of Mr *Houghton's* crops, might stand in a perpendicular posture upon an acre, and room be left. *ibid.*

gardening, has put us upon the use of unmix'd earth, to help such lands as have been worn out. And upon the foot of his excellent experiments in that way, I have chosen to mix the light soils with the stiff ones; supposing, that the sandy soils will open the parts of the stronger lands, and that clayey soils, or such as are close, and which the country-farmers call fat land, will help to nourish and enrich the sand, which of itself is too light to hold sufficient moisture for the support of vegetation, or the growth of plants. In the land you have chosen, you have fortunately a bed of marls to enrich the sands, either on your hills or low grounds. But this need only be used in case you design to proceed in the common way, to turn up your land for corn, or such like: for even the ground, which is now heath on the hills, may be rendered advantageous, by burning and ploughing it to a sufficient depth, and adapting those plants to it which nature at first designed for sandy land. For it is certain, there is not in nature any kind of soil, which has not its proper plant to grow in it, as appointed by the first great Author of all things.

The plants which I find will prosper upon sand of this kind, *i. e.* the black sort, which is your upper stratum, are firs, pines and pinasters of all sorts; but the white sand underneath, to be mixed with it, will be of good use for ash and hazle, which yet will thrive much better if they are sown upon the spot, than if transplanted. For whatever tree is taken out of the ground, and removed to such light land as yours is, must be constantly watered to keep it alive, and the expence will be more than it can be worth in many years; besides, a fresh plantation of such trees as would be necessary for you to put into a wood, would run away with a good sum for props or stakes to support them; and after all, a seedling nursery would be certain to keep it self, without hazard, and in time reward your patience with sure profit; but a more

more particular direction for the forming such a plantation, I shall give on some other occasion. In the mean time, I cannot help recommending, even on the sides of such hills, the sowing of the smallest, or as some call them, the shortest dwarf pease, which may be put in the ground the beginning of *April*, and when they happen to lie exposed to the south sun, I have known them bring good plenty of fruit. I chuse this pea rather than any other, because it takes up very little room, and yet it will bring as many pods as the larger kinds; and besides, it agrees with this light soil, requiring much less nourishment than the other kinds, which run too much into haulm.

When this crop comes off, the same ground, without amendment, will bring excellent turneps, much sweeter than those which grow in a heavier land.

Liquorice is likewise a very profitable crop in ground of this sandy nature; but in the lower grounds, hops will turn to extraordinary advantage, if they are well managed, as they are about *Farnham*, where the soil is chiefly of a black sandy kind.

In ground of this nature, you might allot some of the mountainous part for a warren, although it might be objected that the rabbits would destroy the tender, and even the grown crops in the lower ground; but I am well assured that where these animals can meet with such juicy and succulent herbs, as are frequent enough in low grounds, they will rather do the office of weeders, than destroyers; and their profit will very well recompense the loss that can be sustained, even by their breaking into corn-ground; as I shall in some succeeding chapter endeavour to prove from some warren-accounts, which I design to publish. In the mean while we may be assured, sandy hills, which lie dry without springs, afford us the best tasted rabbits, and most free from distempers; and an acre of such ground will maintain and yield us more in number, annually, than near double the quantity of low ground, where
rabbits

rabbits are for the most part over-fed, gain unwholesome, rank flesh, and are subject to be destroyed by the rot: for it is with these creatures as with sheep, such as have the opportunity of feeding in rich pasture, and grow large and fat, are never so sweet in their flesh as the smallest sort, which feed upon downs where the bite is short. I am, &c. R. B.

CHAP. II. *An account of a farm of four hundred acres, part of which is supposed to be worn-out ground, and the other part reckoned unprofitable heath-ground: with the method of improving the whole.*

To Mr BRADLEY.

SIR,

I Have been three times, in different seasons, at the farm, which I told you I had an eye upon, for the place of my retirement; and shall give you as short an account of the nature of the soil, as I can.

I find I shall have acres enough; there being no less than four hundred; besides the orchard, stable-yards, and the ground which the house, barns, &c. stand upon. Most of this farm is in a miserable poor condition, having been neglected, either from the poverty or bad husbandry of the late tenant: as this is the case, it will require not only a great deal of money to be laid out, but the advice of the most skilful husbandman, to bring it into order.

It borders upon a large heath, something like that between *Wimbleton* and *Putney*; above an hundred acres of this heath belong to the farm, and may all be inclosed. I do not hear that the tenant ever made 15*l.* a year of these hundred acres.

The rest of the farm has been inclosed, and from the age of the trees upon the hedge-rows, and some that

that stand round the old orchard, it appears to have been done above forty years ago; all these hedges and fences are, in one place or other, broke down, and the trees destroyed, excepting in some fields near the house, which as well as the rest have been ploughed from year to year, while they could produce any thing. I believe it has formerly been all black heath, such as is mentioned above, excepting about twenty acres that lie low upon the side of a little running brook, upon which there was a pretty good crop of grass this present year. There are about sixty acres near the house, which have been kept in pretty good order, and both the grass and corn upon them are as good as any in the country about. The soil is generally clay, and the mould, where justice has been done it, is black. I was present when one of the fields was ploughed last winter; I observed it rise in gross clods; but the frost made it fall into a fine mould when it was dressed; and I believe it may be brought to produce any thing, which can be expected from strong black soils. On one side of the house, I find some fields, where the soil for three feet deep is gravel, like that about *London*; upon one of these there is very good wheat: the rest of them are in a poor condition.

The people shewed me two small inclosures, that the tenant had made (upon his first coming to the farm, about ten years ago) from the black heath, which had never been ploughed before. The method he took, was to put a great deal of lime upon it; after which, he had seven crops of corn; the first four or five, of which, were pretty good; but very bad for the last two years. These inclosures have not been ploughed for three years past, and still there is little grass upon them, except upon the tops of the ridges, which being raised very high, nothing but bare clay appears upon the sides; all the earth which had tasted of the lime, being now shoved up to the top. I made a

mandig down three feet, and found the soil a strong blue clay, with some small veins of yellow running through it; which last, is not so strong as the blue, and has some small stones mixed with it; and when I rubbed this upon my hand, I found it mixed with sand or stoney gravel. There is likewise a moisture in this yellow, which I observed run over the clods after it was dug up, and which made them appear like yellow sand without, though they were blue within. Possibly to this mixture of sand or gravel, is owing the mould's falling so fine when it is right dressed. I made him likewise dig down in the open heath, and found it of the same nature and colours, after he got below the roots of the heath. But what gave me the greatest encouragement, was, that by digging in one of the least fields near the house, which is at present covered with very fine corn, I found the soil the same as this, after we got deeper than the plough or dung had gone; which makes me hope, that by good management, it may all be made equally fertile. I must likewise tell you, that where the hedges have not been destroyed, there are very clean, good-like oaks and elms, short of none of their age in the neighbourhood. Having given you this account of the farm, and the nature of its soil, I must beg your opinion, how far you think it capable of improvement, and your advice in the method I should take in managing it.

To Mr BRADLEY.

SIR,

From farmers we may collect the common practice in husbandry of their respective countries; but it is from gentlemen, who have given their time and thoughts to improvements, that we can hope for the most useful advices, founded upon the experiments they have made, from reason and their knowledge in natural philosophy.

My

My letter of yesterday's date was not gone half an hour, when a gentleman who has an estate in *Dorsetshire*, and who has amused himself for some years in the way I propose to do, came to visit me. I presently acquainted him with my design, and our discourse ran entirely upon husbandry.

I shall only trouble you with the advice he gave me for managing one of the fields, which is most worn out. In the first place he advised the ploughing of it, as soon as there should fall rain enough to soften it, the ground being now too hard for any such thing's being attempted; and in this first ploughing he advises the throwing down the earth from the top of the ridges into the furrows. As we have generally rains in *September*, he proposes to plough it a second time, when the first dry weather shall come after the rains; and at this second ploughing he desires that they may go deeper than he supposes ever the late tenant has gone; so that two or three inches of fresh ground may be thrown up, upon which he is for throwing a little lime, which he says will, with the help of the frost in winter, make it fall down fine; and in case I cannot easily go deep enough with one plough, because of the stiffness of the clay, he recommends the having two, the one to follow the other in the same furrow: this will be the more necessary, because he advises that this ploughing be made cross the ridges; but men must be set to work presently, to make drains to carry off the water, and particular care must be taken to keep water from standing upon such land in the winter. When the weather is dry, in *February* or *March*, he desires it may be ploughed a third time, the common way the ridges run, but still to throw it down, in order to the bringing of it more to a level. Presently after this ploughing, he proposes to endeavour to make it fine by harrowing, and employing of men with proper tools to break the clods: this being done, he is for ploughing of it

presently again, if possible, before any rain comes, otherwise it will rise in larger clods than ever. This fourth ploughing is likewise to be made cross the ridges; and as deep as the second, that it may be open to the sun all summer. In the proper season he is for ploughing of it the fifth time, and sowing it with wheat, having first dunged it well.

He gave me directions also for preparing of the dung, of which I shall acquaint you before I finish this letter.

By this method, he says, I shall have a depth of mould equally good; but I must not plough to the bottom of the good mould, when I come to sow: in which case the seed which falls into the furrow, will have good earth below it for nourishment; whereas the common farmers, by neglecting this, lose a great part of the seed by its falling upon the cold barren clay in the bottom of their furrows. He gives me encouragement to expect a great crop of wheat by this method, even from what is now the poorest part of my farm. When the wheat is cut down, he advises the ploughing of it, and letting it lie all winter, and in the spring to sow it with barley and rye-grass, which is called with them everlasting-grass. In order to prepare it for the barley and grass, he advises the ploughing of it twice, first very deep; after which, I am to break the clods, harrow it very fine, and then plough it a second time, laying it as flat as I can; after this I am to sow it first with the barley, and with the grass, before the last harrowing is finished. He acknowledges that this will put me to a great expence, but assures me that the crops of wheat and barley, and the vast crops of grass, which I may expect for a great many years, without being at more expence, will fully answer my trouble.

He gave me the following directions for making a large dunghill, in or near the field.

To chuse a plain spot of ground, and there to dig a pit sloping down to the middle; to throw in
horse

horse or cow-dung about two feet; then to throw upon it the earth dug up, about two feet thick, upon which he desires me to put some lime; after this, dung again, and earth upon that, with lime as before. The earth from the clearing of the ditches, the road, or the rubbish from the repairing of the house, he tells me are all good mixtures. Thus I may repeat the dung, earth, and lime, till it is large enough for the field for which it is designed; and when I have dung enough, I am carefully to cover the dung-hill with turf, or some such thing, from the sun. To prevent too much wet coming upon it from higher grounds, he directs the making a furrow with a plough round it, to divert the water from it; and he likewise advises to take care that the moisture do not run from the dunghill. Also to make the dunghill broad rather than high; and to let all this mixture lie and ferment together, till I am ready to plough the last time for the wheat. If I shall find any grass rise from the earth, he advises the trenching of it next spring, which he says will mix it well together, and kill the seeds or roots of the grass. I am, &c. G. D.

To Mr G. D.

The account you have sent me of your farm is so much to the purpose, that I think myself almost as capable of judging of it as if I had seen it: the description you give me of the soils sufficiently explains to me, that they may very easily be made to enrich one another; and as they are the principal points upon which depends your improvement, I shall begin with examining the particulars, viz.

Heath-soil, which is light and open.

Gravel, or gravelly sandy-soil, open.

Yellow clay, the least binding or heavy.

Blue clay, the most binding.

When you have these four soils in an estate, it is my opinion that you cannot complain; for in the stiff soils there is an excellent prolific virtue; they abound in the vegetable riches, but by means of an oily, or rather a viscous quality, which is in them; the parts are so closely bound together, that they cannot act unless they are opened; and these strong soils in wet seasons ruin corn, though they produce good grass; while the light soil brings good crops of corn, and are not without tolerable crops of grass at such seasons.

In dry seasons corn will come to good perfection (though the straw is short) upon lighter land, but grass will be very little worth; therefore I never prescribe grass to be sown upon light land, unless it be such as is commonly called clover-grass; or if the ground be gravelly, then we may sow saintfoin, which will bring a good crop, especially if the season be not too dry.

When I speak of these soils in this manner, I suppose them always upon a plain piece of ground, but when there are hills, there is a great deal of difference, for the clay flings off the water; and though the sandy hills receive wet, or drink it up when it falls, yet it sooner exhales, and the crops sooner drop than those upon sandy or light earth. On the plain the declivity of the hills answers the end of a drain, and a hill is more exposed to the heat of the sun; for which reason hills seldom give us any rich produce, but as I observe, are gently washed by the rains into the vallies, and thereby give them a rich manure; so that the vallies bring partly from hence good crops of every sort: I allow too, that vallies have commonly the advantage of being watered upon floods, which oftentimes happens, and from the fine part of the earth, which comes among the waters, the vallies are still better fertilized; besides the benefit the water itself bestows upon the earth: it is therefore no wonder that your ground next the river, which lies low, and of course

course may be sometimes overflowed, does bring good grafs.

I come next to particulars, how one sort of soil should be fertilized and improved by another. Your clay-ground, as it happens to be more or less heavy, should have more or less of your gravel or sandy soil laid upon it; for the sharpness of the sand or gravel will open the parts of the clay, and after two ploughings will render that stiff soil mellow, and fit to receive grain.

When such ground has lain three years, turn it up and manure it with your black heath-soil, that is, with such of that soil as is tender, and opened by the roots of the heath: and it is likewise of great use to burn the heath; and lay the heath-ashes with the heath-soil, upon your stiff land; this will enrich the ground extremely. For all that heath-ground is supposed barren in general, yet by experience I find it of excellent use, when it is mixed with clay, for the production of corn.

It is to be noted, that where the soil is very stiff, it should be covered, at least two inches thick, with the sharp sand or gravelly soil: but it will keep longer fertile, if it is covered at first four inches thick, and especially if it be often ploughed; for every ploughing breaks and opens the clods of earth, and mixes the sharper soils with the clay: and that this ploughing may still turn better to account, and that the soil may be kept longer in strength, the crops must be often changed.

As for example, when we have cut barley that has not had clover sowed with it, we must plough our ground for sowing of turneps, which must be hoed after they have appeared above ground three weeks, to stand at the distance mentioned in my *New Improvements of Planting and Gardening*, and managed as is there directed, if there are any markets

for them (a); or else one hoeing will serve, if they are for feeding cattle, such as cows, oxen or sheep; which, if they eat them upon the spot, will still enrich the ground, when their dung, and the rotten leaves and scraps of the turneps, are ploughed in early in the spring. And then if you find the earth too much inclined to clod, lay upon it some of your heath-soil, or sharp sand or gravel, either separate or both together, to be again ploughed with a breast-plough, which is a sort of plough much used in *Glocestershire*, *Worcestershire*, and the counties adjoining: for this plough will break the clods, and mix the stiff and mellow soil together, so that it will be fit for pease the same spring: and in sowing of them we must observe, that if there is a market to sell them while they are green, then they must be sown in rills somewhat more than two feet apart; but if they are designed for seed, they may be sown like grain, to stand about five or six inches apart. It is to be remarked, that this breast-plough does not open the ground above four inches deep.

When the pease are off, turn up the ground with the common plough, and lay it in ridges for wheat; you will then find it mellow and open, and you will have no occasion to use either dung, lime, or chalk: it will bring you such a crop as will very well satisfy the pains and care you have been at; and as I have proved

(a) This kind of root is always sweeter in a sandy soil than in any other ground; but it will have larger roots if the land be somewhat inclinable to loam. From the middle of *July* to the middle of *August*, but not later, the seeds may be put into the ground, that the roots may have time to apple (as they call it) before winter. When the plants have two or three leaves apiece, they should be hoed, leaving the space of five or six inches between the plants; and this crop will be off time enough in the spring either to sow barley or any other grain or seed on the same spot. *New Improvements.*

proved in several places; even excels those lays which have been fallowed and manured with lime, chalk, or dung.

In this way of dressing and managing of land, one great part of the expence is saved. There is no time lost, nor does the soil lose its vegetative quality; but if many sorts of corn were to be sown upon it, so as to follow one another, the ground must necessarily be worn out for corn, but not for other things of a contrary nature, such as turneps, pease, beans, &c. which draw from the earth a quite different nourishment.

And when a due regard is had to change the crops in the manner beforementioned, repeating now and then the manures as above, the ground will constantly improve: it may at any time be laid down for grass, by sowing it with rye-grass, and clover, after it is made as level as possible; or else, there is a sort of *French* grass with a purple-head, that is a fortnight more forward, than any other I have seen to cut for hay; the farmers about *London* know it by the name of *French* grass.

And now that I have said so much concerning the produce of a piece of ground, ordered according to my own directions; it may happen that the feeding of cattle may be rather more profitable than grain, but that depends chiefly on the markets.

As for the lands of a contrary nature from those mentioned before, they are to be relieved by the stronger or stiffer soil; so that when carriages are employed to bring the lighter or more easy soil to the strong or heavy ground, they may carry some of the strong soil to the light ground; but this need only be done upon such land as you design for corn, grass, pease, turneps, and such like; for the lands as they now are, may be rendered fit for some very useful crops by common ploughing only, without any manure.

Your

Your heath-ground newly turned up after two ploughings, is fit to plant saffron upon, which will turn to very good account; it may bring you twelve pounds an acre, one year with another, if you have hands near you to gather it; for not only the goodness, but the quantity of the saffron depends upon its being gathered early in the morning.

These heath-grounds will likewise (without manuring) bring very good potatoes, which is a root very useful. The stiffer soils (without manuring) will bring excellent beans, which may be saved for seed to good advantage, especially the broad *Windsor*-bean.

If you have any design of making beds of proper manure for your light or heavy land; it may be done for the light land in the following manner: sink a trench a complete spit-deep in the ground, and lay therein some of your clay-soil; then over that put a covering of chalk or lime, with some heath-mould, and repeat the same over again, till you think the heap is enough for the ground you design, and turn this over about *Midsummer* before you use it; but if you design an heap of manure for your clay-ground or stiff soil, then make a layer of your sand or gravel screened, and upon that some of your heath-soil, and so repeat these, *stratum super stratum*, till you have a sufficient quantity for your use; and in this case what rubbish you can get from the repairs of your house, will do well to mix with it. This must be turned once before you use it: but when all this is done, I cannot help hinting, that the greatest part of the farmers are in the wrong, when they suppose that land cannot be esteemed fertile, unless it produces good wheat or grain; and so to prepare all their manure on purpose for such crops, and nothing else; or that there can be no rich manure for land, but what is composed of dung, or lime, or chalk. If one can make as much or more profit by other plants,

as he can by wheat or other corn, it is as reasonable to sow or propagate them, as it is to sow wheat or other grain; and I am sure there is no soil in the world which will not bring some crops that may be as profitable as wheat. Your clay-ground when it is first turned up (though I do not make it an instance of what I have just now said) will, after a little breaking the clods, bear a rich crop of flax, and with a little care in manuring this stiff soil with the heath-soil, and the heath-ashes, and a little lime, it will be rendered fit to bear good hops (*b*). And that this may

(*b*) Our author having here referred to a treatise which is now out of print, for the culture and management of hops, we shall here present the reader with the following treatment of that plant, as directed by Mr *Mortimer*. There are four kinds of hops: 1. The wild or garlic hop. 2. The long square garlic hop. 3. The long white; and 4. The oval hop. The first of these is not worth cultivating; the second is a good hop, but generally looking red towards the stalk, it will not fetch such a good price at the market. The long white hop is the most beautiful of all, and produces the greatest quantity. This kind and the oval will grow very well together; they all delight in deep, rich, garden-mould: this may have sand among it, but should never have any clay. Moory black land is what they are generally planted in in *Essex*, but any light land will do. The hop sends its roots four or five yards perpendicularly deep, and for this reason they thrive best of all in lands where there is a good bottom, below what is usually stirred or manured in agriculture. If the hop-land be wet, it must be laid up in high ridges and drained in winter, that the roots be not rotted or chilled. New land is found to succeed better with hops than old; and it is on this principle they are very cautious in their plantations in *Kent*, and look forward for the after-produce. When they make a new hop-ground, they plant it with apple-trees at a large distance asunder, and with cherry-trees between: by this means, when the hops have grown ten years, which they judge to be as much as they will do well, they place their account in the cherry-trees which bear large crops. The dry stalks of the hops should be burnt on the ground in winter; covering them

may answer still better with you, I would advise the making a plantation of alders in some of the strongest ground upon your estate, from whence you may expect

them with a little fresh earth as they burn. This makes together an excellent compost to make the hills of. The land must be dug or ploughed well, and laid very even, and then the places for the hills marked out by a line, and a stick put in every place where one is to be. A thousand hills may be made in an acre of ground, and six or seven plants set on every hill. From six to nine feet distance should be allowed between one hill and another; and the ground in the hills should be better and richer than the common earth, and laid in a foot deep under the surface.

Some plant hops in *March* and *April*; but the most experienced people prefer the month of *October*, because they will then strike firm roots, and be very strong and vigorous against spring. The largest plants are to be chosen, and it is best to procure them from some rich ground, where the hills have been laid high; they should be about eight or ten inches long, and have three or four joints or buds apiece. The holes for planting them are to be dug eight or ten inches deep, and about a foot over; and in each of these holes four plants are to be set, one in each corner. They may be covered an inch deep over the top, if planted in *October*; but if in spring, when they have shot from the joints, then they must not be buried. After this the ground must be kept carefully clear of weeds.

If the hop-ground be poor and exhausted, it should be dressed in winter, and the earth about the hills dug away, and fresh and well-manured soil put in its place; but if the ground be in good heart, it is better to dress it in spring; and if this be done as late as in *April*, it is still the better, as it kills the weeds best of all, and prevents the too early shooting of the hops, which often proves a very great mischief to them.

The dressing of hops consists in preparing the ground in winter and spring, for the making a good summer-crop. In doing this, the hills upon which the plants stand, must be all pulled down, and undermined on every side, till the spade comes near the principal root; then shake off, or remove with the hand, the loose mould from the upper or younger roots,

peet good poles in four years after planting; nor should the willow and black-fallow be neglected, they will produce very good poles in four or five years; the

roots, that you may see where the new roots grow out of the old sets. The old sets are to be carefully preserved, but the other roots may be cut away. Whatever time the hills are pulled down, the roots must not be cut till *March*.

When the young hops are dressed for the first time, all the roots are to be cut away that grew the year before; and the sets are to be cut off within one inch of the same, and every year after they must be cut as close as can be to the old roots: but to a weak hop, some of the shoots are to be left at the dressing. The not observing this single article has been the ruin of many a hop-garden, that might else have flourished. Those roots of the plants which grow downward are never to be injured, but only those which run horizontally are to be cut. The old roots and the young ones may be easily distinguished, in that the old ones are always red, and the young white. If there are, by accident, any wild hops got among the rest, the places where they grow are to be marked with sticks, or otherwise, at the time of their being gathered; and after this, at the time of dressing the ground, that whole hill is to be destroyed, and a new one made with new plants, in the room of the old ones. When the roots are cut and dressed, the rich compost is to be put to them, and the hills must not be made too high at first, lest they hinder the young shoots. If the hops are springing out of the hills, it is always proper to cut them off in the dressing; and one very necessary caution to the owner, is, that all poultry, but especially geese, are to be kept off the ground.

In a dry spring, where there is water near the ground, the hills should be well watered several times; and if the summer prove very dry and scorching, it may be proper to water them once or twice, at distant times, and to lay parings of the earth on the hills, and dead weeds over that, to keep the roots of the plants moist. The hops blow in the latter end of *July*, and in the beginning of *August* they bell, and they are sometimes ripe at the beginning of *September*, sometimes later. When they begin to change colour, and are easily pulled to pieces, and their seeds look brown within them, they

the hazle, the ash, the oak, the chesnut, and walnut, and especially the *Scotch*-fir should be propagated upon such ground as yours; they will be very profitable

they are ripe, and they are then to be gathered as quick as possible, for the least blast of wind will hurt them at this time, and one stormy day may do vast mischief.

The manner of gathering hops, is to take down four hills standing together in the midst of the garden, and to cut the roots even with the ground; then lay the ground level, and when it is swept clean, it makes a kind of floors, on which the hops may be laid and picked. The hop-plants are first unwound from the poles, and then the people sit round the clear place, and pick off the hops into baskets. Another way yet more expeditious, is to make a frame with four short poles, or sticks, laid on four forks driven into the ground, of such a bigness as to be covered with a hair cloth of the kiln, or a blanket tacked about the edges. On these the poles are laid, with the plants on them, and the people pick the hops into the blanket. This blanket is removed when full, and the whole frame is easily removed from one part of the ground to another, as they clear away the plants. When the ground is large, it is proper to erect a little shed to shelter the people employed in picking, and to keep the cut hops in, for them to work upon in a morning before the dew is off from the others. The hops should never be gathered wet; but if any dew hangs upon them, the poles are to be shaken to throw it, in part, off; but if the hops are ever so little too ripe, there is danger of their shedding their seeds by this shaking, and it is very well known, that their principal strength is in their seeds. They will also lose their green colour, and look brownish, which will take off from their value in the market. Some of the people who raise them, bear with this inconvenience, however, to prevent a greater; and as hops waste much more in the drying, when gathered green, than when more fully ripe, they let them hang on the plants till brown; in this case four pounds of hops yield one pound dry, whereas, when gathered green, five pounds make only one when dried; and they get more by the advantage in weight, than they lose by the colour. Some leave pieces of the stalks, and fragments of the leaves, among them, in the picking; but this is very bad policy, for much
more

fitable in themselves, and ornamental to your estate, and shelter your under-crops.

I approve very well of what the *Dorsetshire* gentleman told you about the often ploughing your worn-out field; but I am persuaded the expence of dung may be saved, since you have so many good ingredients about you.

Having now explained how your several soils may be improved by mixing one with the other, and by appointing to each of them the crops which are most natural to them; we shall in the next place consider of the best way of dividing the land into parcels, and of the fencing it with proper trees and shrubs.

The four hundred acres may be disposed after the following manner, *viz.* two hundred acres for corn and grass; one hundred acres for pease, horse-beans, turneps, potatoes, kidney-beans; for seed, *Windsor*, or other beans; for seed, saffron, &c. and one hundred acres for wood; and the fencing in of the whole is one of the first things to be considered (c).

The

more is lost by this, in the price, than is gained in the quantity. Care should be taken to dry the hops as fast as they are picked, for in lying undried they are apt to heat and change colour very quickly. If the quantity picked be so large, that the kiln in which they are to be dried is overstocked, they must be spread thin upon a floor, and they will keep two or three days in that manner without any harm. Indeed, where the quantity is but small, there is no need to have recourse to the kiln at all, for they will dry much better than any other way, by being spread thin upon a floor, and often turned. The drying of hops is the most material part of their manufacture, for if they be ill dried, they lose all their agreeable flavour; and great caution must be used, that they be all equally dried, for one pound of ill-dried hops, mixed among a large parcel of those which are ever so well dried, will spoil all the rest. *Mortimer.*

(c) The inclosures of grounds are in some places made by ditches full of water, and in others by walls either of stones alone, or of stones and earth. Where these materials are in plenty,

The trees for timber, which may thrive upon your soils, are the oak, which will do well upon your blue clay, and the chefnut upon the same soil, if it is not too

plenty, they make very good fences, but in other places, the common method is by quick-hedges. To raise these, a ditch is dug and a bank thrown up, and on this the young trees are regularly planted. The white-thorn is the best of all trees to plant for a fence, being a tolerable quick grower, lasting a long time, and making a very handsome fence. It will succeed on any soil where a ditch and new bank are made, except it be wholly of gravel or sand, and even in this case it will thrive, if there happen a rainy season after the planting of it. Some raise it by seeds, and others by young plants; the latter is the most expeditious way, for the seeds lie two years in the ground before they shoot, but they grow very fast after two or three years. Some prepare the haws, or fruit of the white-thorn, by tying them up in a hair bag, and soaking them all winter; after this, if they are sown in *February* or *March*, they will come up the first year, and grow better than any other way. Where sets are scarce, it is a good way when the underwoods are felled, or rather the year before, to sow haws and sloes in them, and they will furnish a supply of young plants for hedges, without doing the woods any harm, because they may be drawn before they come to be too large. The white-thorn is also of considerable value in some sort of works; its roots become very beautifully veined when old, and elegant boxes and combs are made of it. It is used by some also, in the business of inlaying, and would be more so, if its beauty were more known. The crab and the sloe-tree, or black-thorn, come next in value to the white-thorn, for quicks or fences.

The crabs are to be sown by kernels, pulp and all, and they will come up the first year; and a set of young crabs planted thick enough, make an excellent fence. The black is not so much approved, because it is not so sure of growing, and if it does, its roots spread, and it is apt to run in too much upon the land. The bushes of black-thorn are however the best of any for dead hedges, and for mending of gaps; and they have another advantage over the white-thorn, which is, that cattle are not so apt to crop them. The black-thorn will grow on any soil that the white will, but
the

too springy; upon your gravelly soil, the ash and elm; the walnut will prosper well upon such clay-soil as is the least heavy; and the *Scotch-fir* will thrive extremely well

the richer the mould is, the better it will thrive. Holly is another excellent shrub for a fence; it is indeed greatly the best of all the fence-bushes, but it grows so slow, and is so uncertain, that the farmers are afraid of waiting for it, or of trusting to it; but where it succeeds, it makes amends for the delay, in its thickness, straitness and strength. It is to be raised like the white-thorn, either by sets or berries, and the berries in the same manner lie two years in the ground before they come up. It will grow on any soil, even on the driest gravel, or among stones and rocks. It delights most in light grounds. If it be raised in plants, they should be about the thickness of a man's thumb, and planted in a moist season, either in spring or autumn: they must be shaded well with straw or halm after they are set, and must be carefully watered, as soon as they begin to shoot, otherwise they will all perish. If any of them seem to perish, they must be cut off close at the roots, and they will often sprout out vigorously thence again. The ground must be dug up all about them at times, which very greatly promotes their growth; and the farmer must keep his sheep from them, for they are very fond of cropping the young sprouts. Field-mice are apt to gnaw the roots of the holly in hard winters; and many of these trees are supposed to be killed by the frost, when the teeth of those little vermin have really done the mischief. The best way of raising a fence of these trees, is to plant them with the quick or white-thorn, four plants of that to one of holly; these will thrive very well together, and while the white-thorn grows very speedily, the holly will take its time; as this grows large, the white-thorn may be pulled up between by degrees, till at length, there is only the holly left; and if this is found not thick enough, the boughs of it which grow nearest the ground, may be laid down and covered with earth, and they will send up innumerable suckers, which will fill up all the gaps.

The elder-tree makes an extremely good fence in watery places, and when planted on the banks of rivers, is of great use in preventing them from being undermined by the current; the roots being very numerous, strong, and compact.

well upon your heath-soil, and indeed so will the pine and pinaster, which in twenty years time will make trees worth about ten shillings *per tree*; I have seen them not only valued, but sold at that price; and at the same time some of thirty years growth were sold for twenty-five shillings *per tree*. Particular directions for the raising and ordering these trees are set down in another part of this treatise (*d*); but concerning the transplanting of trees, and especially upon your stiff soil, I must apprize you of a dangerous method taken too frequently by the gardeners, which ends in the destruction of the trees, perhaps in three or four years after they are transplanted, though they may have made a good appearance for the two first years, and been thought in a thriving state.

When the gardeners I speak of, meet with a strong, heavy soil, which they suppose to be unfit for the tree they design to plant, the first thing they do, is
to

It is always sending suckers also from its lowest roots, which makes it very useful where streams wear away their banks, and are widening their course. The furze-bush, though an irregular grower, makes an excellent fence on dry banks, where nothing else will grow. It may be raised either by seeds, or by sets; but the seeds are the best, especially those of the *French-furze*, which grows to the height of fifteen or sixteen feet, and is not subject to spread with its roots and get into the good ground, as our common heath-furze will always do. This has the advantage of being a very speedy grower. It will make a very good hedge in three years, if taken care of. It must be kept well weeded while young; and the sheep must be kept away from it, for they are very fond of its young shoots. But it only requires this care for a little while, for when grown up to any considerable height, nothing can hurt it. If a furze-hedge be clipped, it will grow large and thick; but if left to itself, it will run up to a considerable height, and afford good shelter, and yield an excellent fuel. They sow much of the poor land in *Devonshire* with furze, and make very considerable advantage of it. *Mortimer.*

(*d*) See Chap. XII. Part I.

to dig a hole or pit in the ground where the tree is to stand, and to fill up that hole with fine prepared mould, and plant their tree therein, which for a little while will grow, but when the rains fall, the water lodging in those confined places, grows stagnant, and chills and rots the roots of the tree, until it dies; but, to avoid this, I prepare little hills of the mould, which is to be found upon the surface of such clay-ground, and when it is beat fine with the spade, and has had time to settle, I then plant my trees upon the hills in a thin mud, which quickly settles about the roots, and keeps the air from them, so that none fail. We may make such plantations in *September*, even while the leaves are green upon the trees; if the trees are large, we must take care to stake them well against the winds; but if they are very small, that expence may be saved. In this way of planting, the young fibres of the roots are unconfined, and have liberty to make their way where they best like; but in the holes which are dug in the clay or cold gravel, the trees, if they should live till their roots reach such a soil: yet being confined, as one may say, from sucking of more wholesome food, they are poisoned, and will canker till they die.

But if we raise our trees from seed, in order to make woods, then I find it best to sow such as the oak, ash, chesnut, and such like, with *French-furze*, which screens the young plants from the injuries of the weather, and makes them shoot with clean and upright stems.

When I consider farther of your farm, I cannot omit giving you a word or two concerning the propagating of poultry.

In discoursing on this subject, I cannot better inform you of the methods which should be taken for the welfare of a large stock of poultry, than by laying before you the errors which some have fallen into, who had large numbers of fowls, bought on

purpose to make advantage of them in breeding and fattening them for the *London* markets (e).

I shall

(e) Our author's instance of errors committed in the management of poultry carrying no great instruction upon that subject, we think proper, instead thereof, to substitute the following directions.

The husbandman will be led to the fixing upon a proper number of this kind of stock; and after that, he is to acquaint himself with the choice before he makes his purchase. The industry and curiosity of those who breed poultry for their pleasure or profit, have of late years greatly multiplied what are called the *breeds*: but these differences are not so great as many imagine. They arise from small distinctions, and will sometimes go off in the continuance. Among the several breeds I would advise the husbandman to chuse, not fixing himself to one in particular, according to what he supposes to be its value above the rest, but considering which will best answer the demand he is like to have for the produce. In some measure indeed he is to be guided in this by the circumstances of his farm; he who has a good barn-door, and a rich yard, will be able to keep a proper quantity of the largest breed of these fowls in health and vigour. The common or smaller kind will succeed best with the poorer farmer, for they will support themselves by running about the roads and hedges in a great measure, eating insects, seeds, and whatever can afford a living creature nourishment.

Whichsoever kind he fixes on, let him observe these marks of goodness in the particular fowls he buys. Let the cock be large for his kind, full-bodied, well-shaped, and lively. In the choice of the hen the same general marks are to be observed as in the cock, only her whole aspect should be mild as the cock is sturdy. The proportions of the two sexes is about one to ten, though a single cock will serve twelve or fourteen hens. The yard being thus stocked with these poultry in proper number of the fittest kinds, their age is to be considered; and the husbandman is to be very careful in suiting their employment to that: for it would be very ill husbandry to stop the profitable laying of a young hen by setting her upon her first eggs, when there are such as are fit for nothing else, and will do this better. The farmer is also to have regard to the feeding, for any extreme is equally wrong, whether

I shall conclude these directions for the farm, by taking notice, that the enlargement of your stock of water, by making a fish-pond or two, will turn to account

whether in excess or in defect: the feeding them moderately, while laying or while sitting, is the right method. The best season for the hens sitting is spring and summer, the earlier the better, and the first month of spring best of all. As to the number of eggs to be put under a sitting hen, the best is thought to be seventeen. Let care be taken that they are fresh and sound eggs, and let the upper side of every one of them be marked blue: when the hen goes from her nest, let the whole number be carefully examined, to see if she has turned them all, or any of them, and such as she has not turned should then be turned for her. When a hen is set, she must never be disturbed against her will, and some care must be taken to set her food and water. In the choice of eggs for setting, if there be any larger than usual, they are to be rejected; for they will not lie even, and will cool those that are next them. If it happens that a hen dies, or that a brood by accident become motherless, the best method is to mix them among the chickens of another hen that are about the same age, and she will take care of all together. In large broods especially, it often happens that some chickens are hatched a considerable time before the rest, often one and sometimes two days. In this case, if the hen be careful, nothing better can be done than to leave them with her; but if she be restless, and seem troubled with them, let a little meal be put into the bottom of a sieve, and let them be set in the reach of the warmth of the fire, if the air be chill, and there nursed till the hen has hatched the rest and can take them under her care. During this time, nothing is needful but to keep them warm, for the chicken in the two first days requires no food. For the first feeding of the chickens, the best thing in the world is a mixture of white bread crumbs and small oatmeal. Let a quantity of these be mixed together, and then put a part of it to steep in milk, and keep the rest dry; give the chickens a little of each sort at times, as they follow the hen. After they have thus got a little strength, they are to be fed with bread steeped in milk, and the like; and the hen will by this time greatly assist in the providing for them. In about ten or twelve

account as well for the cattle, as for the fish it will produce; and if you are disposed to have as many eatables upon your own ground as may be required for the service of your house, I believe you will find considerable advantage from such a warren as I have before directed (f).

I am, Sir, your most humble Servant,

R. Bradley.

CHAP. III. *The manner of stocking a farm of two hundred pounds a year with timber, poultry, and cattle, in two letters from Mr W. Waller; with a particular account of the profits arising by cows, either in milk, butter, or cheese.*

To Mr R. BRADLEY, &c.

SIR,

I Have now resided about two years and a half in the west of *England*, where I am possessor of as much land as might be let to farm for two hundred pounds *per annum*; and from the employment I have

days the chickens may be allowed to go abroad with the hen in cool weather, but in the hotter seasons the less of this keeping them within will be necessary, often scarce at all. It is a very material thing to let the chickens, while they are young, have good water, for they fall into half the diseases, to which they are subject, from drinking such as is foul. When they are able to provide for themselves, the hen forsakes them; it is the most useful time for fattening them; to which end they should be put into coops, in a darkish place, and there fed for fourteen or fifteen days: the best food is ordinary wheat-flour made into a paste with milk.

Compleat Body of Husbandry.

(f) See Chap. I. Part I.

I have in it, I enjoy perfect health, a plentiful competency, and the desired sum of every thing, *contentment*. My plenty proceeds partly from the cheapness of the country where I live, and partly from a little art, which I practise, of keeping within my own jurisdiction those useful things which will constantly supply my friend with a good dinner, though the markets were vacant; from such fountains, you may easily guess the enjoyments which are continually flowing for my advantage and satisfaction.

I am persuaded, as you are upon such a work as *A General Treatise of Husbandry*, that some particulars of my management, and an account of the profits I gain from my labours, will not be disagreeable to you; and may perhaps contribute to cultivate in the minds of your readers the useful art of improving the landed estates.

The first thing I did when I came down to this place, was to examine my stock of timber, and agreeably to your directions, to weed out such trees as were not capable of improvement, either because they were past the time of their growth, or had been long kept as pollards, or hurt in their younger days: from these I got a good stock of firewood, some very useful timber towards the repairing my house, and a great quantity of paling, which served to enclose a piece of ground of fourteen acres; and as much more, of all sorts, as was sold for almost thirty pounds; which sum did not only pay my expences of cutting down my wood, and bringing it to the uses mentioned, but left me, in ready money, upwards of fourteen pounds, which I applied to the improvement of the estate in the following manner.

56 A GENERAL TREATISE Part I.

I bought a hundred young elms, which had not been trimmed in the nursery; their height about eight feet, for	— — —	3	0	0
Paid for carriage from the nursery to my ground,		0	1	0
Paid for digging the holes, planting and staking them,	— — —	0	3	0
Paid for trimming two hundred stakes, from the lop of those trees I cut down,	— —	0	1	4
Paid for two bushels of large acorns,	— —	0	5	0
Paid for digging twenty rod of ground, at 3d. per rod, and sowing them,	— —	0	5	0
Paid for one bushel of beech-mast,	— —	0	2	6
Paid for two bushels of ash-keys,	— —	0	4	0
Paid for three bushels of quickset-berries,	—	0	6	0
Paid for digging twenty rods of ground, at 3d. per rod, and sowing them,	— —	0	5	0
Paid for two bushels of <i>Spanish</i> hazle-nuts,		0	10	0
For carriage,	— — —	0	2	8
For digging ten rods of ground, and sowing them, at 3d. per rod,	— — —	0	2	6
For six hundred chesnuts, at 6d. per hundred,		0	3	0
For six hundred walnuts, at 6d. per hundred,		0	3	0
For two ounces of <i>Scots</i> fir-seed,	— —	0	10	0
For digging twelve rods of ground, and sowing them, at 3d. per rod,	— — —	0	3	0
For two thousand elm-sets, at 2s. 6d. per thousand,	— — —	0	5	0
For preparing the ground, and planting them,		0	1	8
I allow for the two years rent of the ground thus employed,	— — —	0	10	0
The ground was already enclosed; so that I shall not guess at the price.	— — —			
The whole amount of this timber and wood-plantation is	— — —	£	7	3 8

The ground being thus disposed, I must confess I was a little impatient to see how my nursery would improve.

When

When I planted my hundred elms, about the end of *August*, agreeably to an experiment you tried at my brother's, I gave them, at least, a barrel of water to each tree; so that the earth they were planted in, was almost like pap, or a thick mud, which I remember the Duke of *Rutland* told me you had advised him to do, in order to settle the earth close about the roots of the trees, and to keep the air from drying the roots, and which, I find since in a letter from you, has been practised by Mr *Johnston*, at *Twittenham*, some years; but his method, by what you observe of planting trees directly in mud, I conceive to be much better than what I learned from you at first, because by what you relate, I understand that gentleman makes every part of the summer season subservient to his art. Pray give me some account, if convenient, in your next, what success that curious gentleman has had in his plantations of this sort. My *August*-plantation, from your experiment, I find to do very well; but I did not trim my trees till the following spring, which I think has given them more strength of shoot, than my brother's trees have, which were lopped before planting (a).

My

(a) All the species of the elm may be propagated either by layers, or by suckers taken from the old roots; but as these are often taken up with very bad roots, and are therefore very subject to miscarry, the method by layers is much the best, and is very easy to be practised, as a small space of ground would be sufficient to furnish nourishment for a number of stools, or roots for laying, which would annually yield a great number. The best soil for a nursery of this kind, is a moderately light and dry hazel-loam, and the best season for laying the branches is autumn. When they have taken root, they should be removed from the old plant, and set in rows in nursery-beds, where, after four or five years, they will be strong enough to be transplanted into the places where they are to remain. In the planting them, great care is to be taken not to bury their roots too deep, which, when the

My acorns came up in six or eight weeks after planting: so that the first year I had several thousand young oaks about four inches high, which, according to the rate of the nursery-men, were worth then at least 2*s.* per hundred; but to set their value very moderately to you, who must allow for accidents in badness of seed, and by vermin, I will only suppose four thousand, which may be about two thirds of my number, and then the value will, in the six months growth of young oaks from the time of sowing, be 4*l.* and the second year (if there happens to be a market for them) about 3*s.* per hundred, which is 6*l.*

The beech-mast, the ashen keys, and the quickset, appeared above ground the second year; some of the ashen keys, indeed, being old seeds, as you have observed, came up the first year; but I have now a large number of each that make a good appearance, and will serve to plant a large piece of ground, which I am about to purchase: to reckon only 10*s.* per thousand for my beech and ash-plants, I have enough to bring me 3*l.* 10*s.* and my quickset, which is excellent to plant fences, amounts to about nine thousand plants, for which I am offered 10*s.* per thousand at Michaelmas next, so that their amount will then be 4*l.* 10*s.* which, with the 3*l.* 10*s.* value of the beech and ash, is 8*l.*

Of the hazle, I have hardly two thousand plants, which, according to the rates given for the slips and sets of them, in the gardens about *London*, may very well be worth to me or my neighbours, 2*s.* per hundred, with less uncertainty in transplanting, and less expence of carriage; so that their value is about 2*l.*

Of

the soil is moist and stiff, often destroys them. The common elm seldom produces seeds in great perfection, but the witch elm produces great quantities of good ones, from which some people raise nurseries of the trees. *Miller.*

Of the chefnuts and walnuts, one with the other, I have not above feven hundred plants, but they are prosperous; and, I think, may at a moderate price be valued at 2*s.* 6*d.* per hundred, which makes 17*s.* 6*d.*

My *Scots* fir-seed came up the first year; so that I expect they will be near two feet high this summer, and then at a moderate price, as I am told by the gardeners about me, will be worth 15*s.* per hundred. From the two ounces of seed, I have about eight hundred, from whence I suppose above half the seed was lost, either in the ground, or devoured by the birds, who are very voracious of them; but to defend my seminaries for the future from the birds and the snails, which are very fond of them, while they are in their tender shoot, I have contrived a frame, to enclose each bed, of planks pitched over, and thickly covered with glass, beaten moderately small, so that no snail or slug can crawl over them, to get at the young plants; and part of an old net strained over this frame, keeps the birds from doing any damage (*b*). My nursery of firs, according to my reckoning, comes to 6*l.*

Out of the two thousand elm-seeds, I have only about one thousand that are come to any account, which are now worth 5*s.* per hundred at a moderate price; so they amount to 2*l.* 10*s.*

Allowing my calculation to be right, the account stands thus.

	£	s.	d.
Oaks four thousand, at 3 <i>d.</i> per hundred,	6	0	0
Beech and ash-plants seven thousand, at 10 <i>s.</i>			
per thousand, — — — —	3	10	0
Quickset-plants nine thousand, at 10 <i>s.</i> per			
thousand, — — — — —	4	10	0
Hazle-plants two thousand, at 2 <i>s.</i> per			
hundred, — — — —	2	0	0
			Chefnuts

(*b*) See Chap. 12. Part I.

60 A GENERAL TREATISE Part 1.

Chestnuts and walnut-plants, seven hundred, at 2s. 6d. per hundred,	£	s.	d.
	0	17	6
Scots-firs eight hundred, at 15s. per hund.	6	0	0
Elm-plants one thousand, at 5s. per hundr.	2	10	0

Value of my nursery and seminary, in its third year, without reckoning the hundred large elms, — — — 25 7 6

Expence of raising the above plants, as by the former account, — — — 7 3 8

For care of them in watering, &c. — — — 0 10 0

Whole expence of this nursery, — — — 7 13 8

Clear profit in the nursery, — — — 17 13 10

But it remains that I give you an account of the rest of the money which I gained by the weeding my woods, and how I have employed it to the advantage of my estate; the sum in ready money was 14*l.* of which something more than 7*l.* was expended in the nursery, so that there remained near 7*l.* for other improvements; but as they are of a different nature from those I have mentioned above, I shall rather chuse to send them some other time.

I am, SIR, Yours, &c. W. WALLER.

Fifteen days after I received the foregoing letter, I had a second from the same curious gentleman, part of which, so far as it relates to husbandry, I shall insert for my reader's instruction.

In my last I promised you some further account of the method I took to set my little estate in order, and first I shall mention the living creatures I bought in for store.

I bought two dozen of chickens of the kind which has white feathers and legs, and which I had heard say carried flesh of a much finer grain, than the larger

sort

Chap. 3. OF HUSBANDRY. 61

sort with other coloured legs and feathers. These cost me 4*d.* a piece one with another, and were about the bigness of those which one may buy of the farmers about *London*, for 6*d.* a piece unfed, — — — — — 0 8 0

Of geese I bought ten couples, a little before harvest, for 1*s.* a piece, — — — — — 1 0 0

About the same time I likewise purchased twenty turkeys, which cost me about 1*s.* each; having paid for them in stock-wood, amounting to 1*l.* as it was valued, — — — — — 1 0 0

I bought two dozen of tame ducks, at their *Midsummer* growth, for 6*d.* each, — — — — — 0 12 0

Six pair of pigeons of the same kind with those sold by the famous pigeon-merchant at *Turnham-green*, near *Breniford*; they are of a large sort, and as I was told, first brought to *England* from *Italy*; these cost 2*s.* a pair, 0 12 0

Sum Total £ 3 12 0

I chose them, rather than stock my dove-court with the common, wild, blue pigeons, because we may draw young ones from these tame pigeons, almost at every season of the year, and one of these has more flesh than three of the blue sort; and besides, the wild common pigeons breed but a small part of the year, and even they must be, for the most part, fed at home, if we expect any advantage from them; so that to compare the expence and profit of the one with the other, I conclude there are more advantages arising by keeping the large tame pigeons, than the wild ones. Thus it appears that the prime cost of the poultry I bought in, amounted to 3*l.* 12*s.* and the offal of my farm-yard kept them all in good plight, (except the pigeons) till we had occasion to feed some for killing; and then the pollard which we fattened them with, as it was the produce of my own ground, did not stand me in above 3*d.* for each fowl; so that

to lay the most, a good fat chicken, which would cost from the poulterers in *London*, about 3s. I could eat at home for about 8d. charge.

The early raised pullets gave me as many eggs in the winter, as I used in my family, and brought me as many chickens as almost trebled my number; so that I was either to chuse whether I would sell some, or allow them more food than the barn-door, or the waste of the farm would afford them; but as I had corn by me, at little more than half the price I must pay for it at market, I rather chose to give them now and then a little extraordinary food than part with them; or suffer them to wander out of my bounds to seek for it.

My ducks and geese, who had water enough in the ponds near my house; got a good share of their food from the water-weeds and insects they found there; and by the help of an adjacent common, with my stubbles, were kept, as well as my turkeys, for some time from being over-ravenous when they came home. I had so great an increase of all these, besides a good quantity of eggs, that one third part of them were sold in the markets for upwards of 3l. 10s. which was above one third more than the value of the extraordinary food required for feeding the fowls remaining in farm; and what one might reckon for the attendance of the woman that looked after them (c).

I have at present about twenty acres of cow-pasture, besides common, and the advantage of some turneps for winter-food; by this means I maintain nine cows, but had I might add two more to my number. The cows, however, which I have at present, give me each of them about three gallons of milk a day at least, which together yield twenty-seven gallons a day, but sometimes they give me forty gallons in a day, from whence I have a large quantity of whey and

(c) See Chap. 2. Part I. Note (e).

and base-milk to assist the feeding of twelve swine, two of which are breeders. In my choice of these, I rather preferred the black *Bantam*-breed, than the large sort common in *England*, though I do not believe this black sort eats less than the common large kind, nor perhaps do they yield so much profitable flesh for market by one fourth part, as the others; however it is certain, that their flesh is much more delicate for the table than the common *English*-breed; whether as sucking-pigs, or in pork or bacon. Again, I should remark, that for the better feeding of these creatures, I have a considerable help by brewing my own drink, from some offals of my farm-yard, and the mast of the woods. But I shall be particular in another letter, if you desire it, and give you a stated account of my advantage by milk, cream, butter, cheese, calves, pigs, pork and bacon; and shew you at the same time, how to judge of the expence in keeping these creatures upon a farm, ordered as mine is. To which I can add, if you are not already apprized of it, the method of feeding and curing bacon, as the farmers practise in *Hampshire*, which county exceeds most, if not all others in *England*, for flesh of that kind.

It is to be observed, that in feeding cows we must not let them range in too large a piece of ground at one time; I have therefore divided my twenty acres into three parcels, which I turn my cows into from one to another, as I see occasion; commonly I allow them eight or ten days in one, before I change them to another, for they otherwise would trample down and spoil a third part as much grass as they eat. By this changing of place, and the liberty I have of some common and waste-ground, they have hearty food, and pay me well for it: for if we were to enquire no farther than the common expence of feeding these cows by the week, which to hire land would be 15. 6d. per week for each, the charge of feeding my nine
cows

cows would be 13*s.* 6*d.* each week; and the calves pay the interest of the money I first laid out in their purchase, and in great part make amends for the time lost in the cows growing dry. Now allowing that I have from these cows only twenty-seven gallons of milk in a day, which is a mean quantity, (for some cows will yield singly upwards of three gallons at a meal;) then the value of my milk, was it to be sold for 1*d.* *per* quart, would amount in a day to the sum of 9*s.* and in seven days, or one week, to 3*l.* 3*s.* from which sum, if we take out the 13*s.* 6*d.* for their week's grazing, there will remain, neat money, 2*l.* 9*s.* 6*d.* without farther trouble than bare milking: but the managing this milk in the dairy, makes it worth more than double the sum, as I can prove by my farming-accounts. However at present I shall only take a view of the plain profit of milk from nine cows, at the aforesaid rate, for one year, and you may partly guess at the advantage to be reaped from them: supposing the food of a single cow, throughout the whole year, comes to 1*s.* 6*d.* *per* week, and that one day with another, for twelve months, a cow will give six quarts *per* meal, *i. e.* three gallons a day, as I have before related; then we find the milk of nine cows to be worth 164*l.* 5*s.* a year, but taking from that sum, the charge of feeding the said number of cows for that time, which comes to 35*l.* 2*s.* there remains clear profit, 129*l.* 3*s.* a year: and if we deduct from thence the price of the nine cows, which was about 50*l.* there yet remains the advantage of 79*l.* 3*s.* which is a very good interest for money laid out in cattle, and their year's food paid for. But when I come to mention all the advantages I make of them, you will find my profits more than double what I have related.

I have seen some of the *Cbina*-geese, which I find answer your character of them, *viz.* that they are larger than the common sort in *England*, and breed earlier;

earlier; but I find the young ones are very tender, and are both difficult to hatch and to breed up; therefore I content myself with our common kind, which seldom bring me at a setting fewer than ten, eleven, or a dozen apiece. I am not yet fallen into the way of pulling their feathers, as they do every year in *Lincolnshire*, and other fenny countries.

In the breeding of turkeys I have found some difficulty, till I took the advice of the woman who looks after my poultry, who by keeping the young ones with the hen in a barn or out-house, till they are about six weeks old, preserves them in good health and a thriving condition. She tells me, that it is not only necessary to keep them warm for that time, but likewise to keep them from eating small snails and slugs, which they would find abroad, and would scour them to death. After six weeks she brings them out with the hen, and places them where the sun is moderately warm, so enclosed in an open case of wicker, as to prevent their ranging; then she feeds them as she did from the beginning, with curds, in which are a little rue cut small, and some ant-eggs; and puts them again into the house as soon as they have enjoyed the warm air for two hours; allowing them, from time to time, as they grow more hardy, so much more time abroad, till at length they become capable of shifting for themselves. But I must not omit to tell you, that soon after they are hatched, they should have a fresh turf of short grass every day, but without snails or slugs upon it, for the reason before mentioned.

The reason of this letter to you, is chiefly to put you in mind that husbandry does not alone concern the methods of cultivating land for corn and hay: for that is the least part of a farmer's business.

I am, SIR, Your humble Servant,

W. WALLER.

To these accounts we may very well add the following observations relating to cows, their food and pasture, and how far the goodness of milk, butter, and cheese, may depend either upon the kind of cattle, the soil where they are grazed, or the management in the dairy.

I observe only three sorts of kine in *England*, which are remarkably different in their colour, viz. the black, the white, and the red.

The black sort is commonly the smallest, and it has been observed is the strongest for labour. We find cattle of this colour chiefly in the mountainous countries, where they are still much smaller than when they enjoy the free nourishment of the low rank grounds; but yet I have never observed them of so great a stature or bulk of growth, when even they have had the richest pasture, as is common in the white and red kinds: and it is a remark of the old authors, not unworthy our observation, that the black kine, about sixty years since, were chiefly bred in *Cheshire*, *Yorkshire*, *Lancashire*, and *Derbyshire*; which counties chiefly supply, as I am informed, that large quantity of rich cheese, which we receive under the name of *Cheshire-cheese*: and it is observable, that the cows of this colour yield seldom more than a gallon of milk at a meal or milking; but to make us amends they continue milch, or in milk, till within a very few days of calving, so that we can hardly say they are ever dry: whereas the other sorts (these remarkable for being of a white or a red colour) will, after calving, give large meals of milk, near three times as much as the former, but grow dry much sooner.

The white breed of kine (according to some remarks of a very learned gentleman, which I have now by me) were very frequent in *Lincolnshire* some time ago, from whence he first brought them into *Surry* as a curiosity; they are of different make, and much larger than the black

black cattle, and give more milk at a meal, but grow dry very soon: it is observed likewise in the same remarks, that many of this breed were then in *Suffolk*; and I wish he had gone so far as to have given us some reasonings upon those coarse cheeses which we call *Suffolk*-cheese, and why they happen to be harder and drier than any in *Europe*.

The red kind is commonly the largest of any sort we have in *England*; and, it is observed by some farmers, will give more milk at a meal than the cows of any other colour: it has likewise been the opinion of physicians, that the milk of the red cow is more nourishing than that of any other sort of kine, as is remarkable by their prescribing it to consumptive persons. But to proceed upon my own observations; wherever I have had an opportunity of examining into this part of farming, which relates to the dairy, I have always found the red cows to give much more milk than the black sort, where the farmers have been wise enough to keep one genuine breed of kine from mixing with another. The mixing of these sorts, I suppose, has been a mean of producing the pied kind, now pretty frequent, and of bringing the more lusty race into degeneracy, as it has brought the dwarfish strain to be of a larger size than they were originally; and at the same time, the qualities which were admired in either distinctly before the coupling, are now so confounded one with the other, that their original perfections are hardly to be traced out.

The red cows do not only give, for the generality, more milk at a meal than those of other colours, but bring better calves too, notwithstanding the contrary has been maintained; some even affirming it was impossible that a calf could be completely nourished in the matrix, where the milk was abundant in the dam. Others again tell us, that the natural black kine which give milk all the year, cannot bring good calves, because, say they, where this milk is conti-

nued during the whole time the cow is pregnant, it must certainly draw away the nourishment which is requisite to feed the calf while it is enclosed in the matrix.

To answer the first difficulty, I think we need go little farther than what I have said before, i. e. that the red or larger sort of cow which gives great quantities of milk at a meal, becomes dry sooner after her pregnancy than others; so that when the calf begins to grow in the matrix, all the juices of the body are turned to its nourishment, except such as are lost by perspiration, or the feeding of the hair upon the red cows, which hair is always said to be much stronger upon the cows of this colour than upon the black.

On the other hand, though the black kine give less milk at a meal than the red, yet they continue milched till near the time of calving; which sort of cow, in some cases, is rather to be chosen, than one which gives a great quantity at a meal, and goes dry soon, for reasons I shall explain hereafter. These natural black cows, if they have free pasture or are well fed, will, as I am told, yield, one time with another, completely six quarts of milk *per* day the whole year round. And considering the time that the red cows, or such as are deep milched, are dry, the milk of the black in one year exceeds that of the red in quantity; but then if this milk is for dairy use, it is right to keep a deep milched red cow to calve about the end of *March* or beginning of *April*, that she may be come to her milk just when the spring is coming in, and the grass is full of vigorous and nourishing spirits, which will greatly add to the quantity of milk she will give at a meal. I have three or four times been witness, that a large cow has given in one day, upwards of thirty-one quarts; but such extravagance soon declines, and the cow is unprofitable during a good part of the year, unless we let her calf go along with her; and this is no way agreeable to the

the rules of the skilful farmers; they value the milk for dairy-use, while the grass is long and rich, more than the profits which would arise from a calf at that season. But when a cow calves about *October* or *November*, the calf may be brought up for increase; the milk then being not so fit for the dairy, the calf will be more hardened against distempers, and thrive by the nourishing food of the following spring, and be much more gentle and familiar than if it had at once fallen in with plenty at its birth. But it is now time that I say something of the pasture and food of cows, and how much the goodness of their milk may be influenced thereby.

And, first, we must suppose that the juices of every herb are fuller of spirits, and more nourishing, when they are in the vigour of their growth, than when the cold puts a stop to their vegetation; for in some aromatic herbs, when the cold begins, they lose their spicy smell; and again, when the warmth of the spring begins to move their juices, they regain their odour; which shews that, by cold, plants lose the spirits which by heat they possessed; so that the milk of kine cannot be supposed to yield that nourishment when the cows feed on herbs out of growth, as it will do when herbs are springing; and to prove that the milk of an animal can be influenced by herbs simply, or by heat or cold, which alters them, I shall give some instances:

First, When a cow feeds where crow-garlick happens to grow amongst the grass, the milk will assuredly partake of the relish of the garlick. I have often seen cows feed upon it, and have as often found the scent of garlick in the milk, as I have had an opportunity of using it; which plainly demonstrates to me, that, notwithstanding all the different filtrations of the juices through the body of the animal, yet it is necessary, from nature, that every part of the body should draw some nourishment from the diet of an animal, or

the food which every creature receives into the stomach, and that the herbs which cows feed upon either meliorate or hurt their milk.

Secondly, At the time of the year when the leaves fall, we find that the milk of those cows which feed upon them is bitter to the taste, and very apt to turn or change; so that we may reasonably suppose, that the falling-leaves have an influence over their milk. It is not uncommon to see cows feed in this manner, nor is it more rare to find milk influenced at that time, in the manner already observed; but whether it be from the leaves in general that fall, and then tend to maturation, or from leaves of particular plants, may be considered hereafter.

Thirdly, About autumn it is customary near *London*, to feed the cows with turneps of a large kind, commonly called the cow-turneps; and these are used in many places with indiscretion, by giving the cows both the leaves and the roots, as they are fresh drawn from the field: the milk in this case will likewise be bitter, though the cows cannot get at fallen leaves. But some farmers, who are a little curious in the food of cows at this time of the year, have the leaves cut from the roots, and let them lie some time together, two or three days perhaps, before the cows eat them, and then they observe the milk is not bitter: but then we must take notice, that the use of the turneps at this time, when grass is scarce, is to keep the cows full of milk; for the dry meat, or hay alone, the herdsmen suppose will dry the cattle: therefore the turneps are used, as being plants full of juice, and said by the cow-keepers to fill the cows with milk, which might give us a farther opportunity of reasoning.

With these turneps, and some other greens, are cows often fed in the winter about *London*; but these herbs alone are too full of juice for the health of the cows; and therefore the other part of their food is hay, which is commonly of the coarsest sort, such as is made

made in orchards, growing rank under trees; or such as is made of the grass of a second spring: but I find by experience that the best hay is the best for cows; it nourishes in the winter, makes them strong, and keeps them in milk, provided the cows are turned in the warmer part of the day into grass, especially such as has had dung spread over it about the end of *August*, before the rains fall.

It is certain, that cows which feed in the spring upon high grass abound in milk, but that which grows rank in orchards is commonly sour; and though the cows will eat it either in grass or hay, yet their milk is always poor and apt to change: their bodies are not strengthened with such diet; and though they continue to give milk while they eat such trash, yet it has been pretty well experienced, that good grass of the spring, or hay made of grass in its excellence, will give so much strength to the kine that feed upon it, that the advantage of milk will very well pay the expence, and make the milk better tasted; for where the diet is good, the body will be strong, and in this case will yield abundance of milk, and especially such as is of good use in the dairy.

In *Somersetshire*, and some of the western parts of *England*, near the place where the famous *Chedder* cheeses are made, the lands are commonly flat and low, and are often so well watered, that the grass is very free and vigorous; the cattle indeed are of a large strain, for in this sort of land it seems the kine find large subsistence; their parts and vessels are naturally larger than the other sorts; and they gather nourishment enough from their food to fill their vessels and parts, in such a manner as to make them surpass all those of the same breed, which feed in the more hilly or dry countries.

In *Lincolnshire*, and other counties where this sort of cattle is fed in marshes, we find them grow to a very large size; but we may remark, that these

marshes are rather used for oxen than cows: but however, where cows have an opportunity of such food, and are of a large kind naturally, their milk makes much fatter butter, than that of those which are fed upon short grass; for a proof of which we might instance *Holland*; where, according to my observation, is found the fattest or richest butter in *Europe*; and there the cows feed in salt marshes.

But again, if the milk be perfectly good, it may be spoiled by bad management in the dairy. In *Devonshire*, and some other counties in the west of *England*, I observed that the butter in many places tasted of smoak, and was apt to grow rank soon after making, which made me curious to enquire into the cause. The milk of itself was good, and the cream was rich; but I found that the method of making it into butter occasioned both the evils: for, first, I found that the milk was set in brass-pans; and in the next place, the butter was made in brass-kettles over a fire, without a churn: from whence we may easily conceive, that the best milk, with this management, could never yield good butter; for it is certain, that brass will communicate part of its rank quality to any liquor kept in it: but especially when it is warmed over the fire in brass-vessels, for then it must certainly partake of the qualities of the brass more than it did before in the dairy-pans.

One of my correspondents computes, that butter, cheese, and the product of milk, amounts to more than an eighth part of the money gained by farming in *England*; and he adds, that the money to be gained by this branch might amount to much more than it does at present, if all our country-dairies were to follow the examples of those who excelled the most in the dairy-way. I confess, that I agree with him so far as the dairy-management is concerned; but on the other hand, we must consider what is before related, that soil, grass or herb, and the nature of the kine must

must first be exactly taken care of; and where these all concur, I find the *London* markets will give in the value of one pound weight of butter, four pence or five pence more than it would bring, if it wanted any of these helps: so that butter well made, cannot fail of raising as much money, as will gratefully reward the care and industry of the farmer.

Of cheeses we may observe many varieties, partly from the dairy-management, and partly from the food of the cattle: it would be well worth the farmer's while to collect the several receipts for making cheeses, from the most noted places, and in a particular manner to observe, that in such cheeses as are designed for keeping, the curds are broken very small; and as equally as possible, that when the cheese is put into the fat, every part of it may be equally pressed, so that never a drop of whey may remain in it; for it is for want of this care, that we so often find cheeses full of those hollows which are called eyes in cheese, and occasion great loss to the farmer.

I am informed that in *Wales* it is common to mix the cows-milk with that of goats, sheep, mares, or other cattle. I have there tasted excellent cheese, exceeding those of *Cheeshire*, in high flavour and richness.

I remember a *Dutch* merchant once told me, that he had sent some of the best *Holland* cheeses to the *East-Indies*, and received one of them back in greater perfection than he had ever tasted any. His method was to lay them in oil, and stop them close up in earthen vessels, which, he says, helps them extremely, when they are about passing the line, where the heat is so great, that cheeses are commonly lost by it, without such caution as he used. One of my acquaintance is often at the expence of *Canary*-wine to keep his cheeses in, which renders them very mellow, especially if they have the help of moderate constant warmth, about a fortnight before they are cut. The angelots
might

might surely be made as well in *England* as elsewhere, seeing we have in some county or other, the same food for cattle that other countries afford.

CHAP. IV. Concerning the management of a piece of ground about one acre, with some observations relating to fish, poultry, rabbits, and preparing or curing of pork and bacon, adapted to the service of a family of seven or eight persons, in a letter to Mr A. B.

SIR,

ACCORDING to your desire I am set down to give my thoughts concerning the advantages you may reap from the piece of ground which you design to make into a garden of profit. And first, I shall prescribe the method of fencing that part of your ground which lies next the river, so that the brisk current of the stream may not continue to wash away any of your ground; and even through the same means you may recover that ground which you have already lost by the rapid course of the river.

When you have found how far your original bounds have reached, provide long setts or stakes of willow, rather with their tops on than cut off, as the common way is, unless there should be occasion for any force to drive them into the ground, for then the tops cannot remain on them; but for the way of planting them, it is commonly done by means of an iron-crow, or a pole guarded or pointed with iron, to make the holes for them.

These holes should not exceed a foot distance one from another; and the setts should be put a foot or more into the ground, or two feet if possible; when they are all planted, wattle them, with willow-
twigs

twigs, together at the top; and in two or three years the stems will become so large as to meet within seven or eight inches of one another, and in five or six years within two or three inches, if they like the ground.

In the mean time the current of the river, which formerly annoyed and washed away your land, will be resisted and diverted from its wonted violence by the living fence of willows, and you will have time to fill up the intermediate vacancy between the land and the willows with rubbish, or such like materials; as will lay a sure foundation for the recovery of your lost ground.

But as all rivers are inclined to rise or fall in their waters, we may chuse those seasons of filling up the vacancies between the land and the willows, when we least expect floods and inundations; that the earth, or other matter, which we lay to fill up such places, may have due time to settle and fix itself before the rivers increase their waters too much; for fresh-laid ground will wash away by every little motion of the waters: It is then loose and light as wheat-flour, which will float upon the water; but when it has had time to settle and fix itself, is like flour made into a paste, which then has its parts so closely bound together, that water can hardly separate them in a long time.

I would advise the willow-fetts to be planted rather with their heads on, than to have them cut in the common way, because this cutting robs the fett of its freedom in circulating its sap; for we must consider that many vessels, which are known to convey sap, must lose that function by pruning or cutting; and when a plant is put into the ground without a root, it is always necessary to preserve as many vessels entire as possible; for by experience we find, that the less a plant is wounded, the better it will grow: and for this reason we practise the cutting and wounding of

of fruit-trees, which shoot vigorously, to check them, and bring them into a bearing-state; for such wounding takes off the vigour of the tree, and brings it to such a moderate way of growth as makes it produce fruit; but in the case of forest-trees or willows, where fruit is not our design, but encrease of bulk is our chief end, every thing should be done to advance their vigour.

But let us now proceed to the garden itself. Near the river-side, you tell me you have a canal of one hundred and forty feet long, and twenty-five feet over; and this, you say, either has at present, or may have, a constant communication with the river, by means of a wheel which the river may turn constantly, and which will throw water into your pond. Now it is certain, that where such a current can be maintained, a pond of the same size will feed and keep half as many more fish as it would do if it was only standing-water, or fed by a little spring; for in the constant course of the river-water through it, there will be a constant supply of feeding-matter brought in with the water, which will be both grateful and nourishing to the fish; and especially, if your canal be so made, that the fish in it may give to breeding; but that should be always avoided, where we would have our fish thrive and grow large; and if we would prevent their breeding, it is necessary to let the sides of the canal be cut downright, and fenced up with plank, so that there be not any part of the canal less than two feet deep in water at least; for a water of that depth, will never hatch any spawn of pond-fish: and then if we take this care of our fish, rather to make them feed than increase, we must also provide some deep places in the canal, of about six or seven feet water; for it is a certain rule, that all fish, in proportion to their bigness, will chuse to lie in the shallowest or deepest waters; the
very

very small ones in the shallowest places, and the very large in the deepest; for without such depths, the very large ones will not thrive (a).

In a pond of the bigness you mention, if the river was not to feed it, you might maintain about fourteen brace of large carps, and twice as many tench, to thrive well; but as the pond is fed by the river, you may well enough maintain twenty-one brace of carps, and forty-two brace of tench, and expect them to prosper, without giving them any extraordinary feeding; but for the sake of the pleasure it may be to you in viewing your fish now and then, it may be proper enough to use them to feeding at some certain hour every day, that you may take them as you see convenient; they will soon know you, and come at any call you use them to, as I have often seen in many places:

(a) Fish-ponds are not only a thing of convenience to great families, but may be made a very profitable article with the farmer, under due management. Watery and boggy lands are often fit for no other use, and these are then a great improvement on them. Ponds made in dry grounds in the flat bottoms between hills, will also serve not only to supply the cattle with water, but the profit of the fish that may be bred in them, is greater than many are aware of, and comes without any labour or expence. The head of a pond must be placed at the lowest part of the ground; and the trench of the flood-gate or sluice, must have a good fall, that it may not be too long in emptying. The best way of making the head, is by driving three or four rows of stakes about six feet long, and at about four feet distance from one another, the whole length of the pond-head; the first row of these is to be driven in four feet deep, that they may be very firm and secure; and if the bottom be not good, but be of a loose sand, some lime is to be added, which will harden into a sort of stone. The earth dug out of the pond is to be laid between these stakes, and rammed hard down. Other rows of stakes must be added behind, and over these; and the spaces filled up till the whole is as high and as thick as is necessary. The face of it must be made even and slanting, and there must be a wash left to carry off the superfluous water in floods, &c. *Mortimer.*

places: and if among your carps and tench you was to put some trouts and bream, they would become as tame and familiar as the rest.

I have seen carps thus tamed, fed with raspings of bread, with green-pease, and at *Rotterdam* with spinage-feed, which they eat very greedily; but the trout is commonly fed with paste made of wheat-flour and water.

When you store your pond, put in the smallest fish you can get, and rather the spawn of one year than of two; or rather of two years old than three, for the younger they are when they change the water, the better will they thrive; nay, a fish put in at three years old, will not at six years be so large as a store-fish put in at one year old, will be in three years.

The feeding of fish in ponds where they breed, has yet another convenience; for the small as well as the large ones will come to the feeding-place at the feeding-times, and may easily be taken with a net, and removed to other ponds, without the trouble of laying our ponds or canals dry; and it is necessary that we every year discharge our breeding-ponds of the young fry, or the greatest part of them, for they rob the greater fish of their nourishment, so that they do not grow half so much as they might do. An instance of this kind I observed in the little pans in which I hatched my roach, dace, bleak, &c. for though they had earth at the bottom of the pans, and fresh river-water every other day, besides wheat-flour, grated bread and paste, yet, in *September*, they were not above half as large as those that were hatched in the river, and had the liberty of natural food. Thus far we may discover, that it is not our interest to crowd ponds with fish, for if a pond be over-stocked, the fish never thrive.

In the spring-season, when frogs and toads begin to appear, suffer as few as possible in your carp-ponds, and destroy them before they spawn, so that they and their

their generation may perish at once; for whether these horrid animals do mischief or not to the carps, by poisoning of them; as is reported, they certainly rob the carps of great part of their food.

It is likewise improper to have any eels in a carp-pond, whether the pond be for breeding or feeding, for they are great devourers, especially of the spawn of the fish; unless indeed a pond be over-run with frogs and toads, and fish do not breed in it; in that case the eels will help to destroy those vermin (*b*).

But let us now see what profit you may expect from your canal, which contains about twelve rods of water. We shall suppose that all the fish you stock your pond with,

(*b*) All fish-ponds should be drawn once in three or four years, and the fish sorted; if it be a breeding-pond, the smaller fish should be taken out to store other ponds with; and in feeding-ponds, all the fish should be kept as nearly as may be of a size, for the larger and smaller never all thrive well together. Flounders will both thrive and breed in any pond, especially in a clay-pond, and will be much larger than in rivers. Bitterns, herons, otters, water-rats and sea-gulls, are all great destroyers of fish, and the ponds should be kept as clear as possible of them; but the greatest of all destruction in fish-ponds is occasioned by frosts. To remedy this, some propose to break the ice and lay in pipes, straw, and other things, to give air to the fish, but all these fail when the ponds are foul; but when they are clean, the fish seldom suffer any harm, be the frost ever so long, and that though no holes be broken in the ice. The stench of foul water seems to be the occasion of the death of the fish, in this case of its being locked up by frosts, and not the want of air. The cleaning of ponds frequently is of great use as well on this as on many other occasions; and it is done at no expence, because the mud serving as manure to the lands, more than pays the expence of taking it out. When the ground is boggy, and carts cannot come up to take the mud, it is best to cut the ponds long and narrow in form of moats, that it may be thrown out at one toss by the labourers in the clearing them, for if it require two tosses, the difference will be just double the price of labour. *Philos. Transf. N° 91.*

with, are spawn of one or two years old; and three years after stocking your pond, if it feeds pretty well, your carps will (at a moderate price) be worth 2s. and your tench 1s. apiece; for these are rarely brought to market but in *London*, and even there the prices I set are not esteemed dear.

	£	s.	d.
Then your forty-two carps are worth,	—	4	4 0
And your eighty-four tench,	—	—	4 4 0
Which makes,	—	—	8 8 0

Now this sum alone, divided into three equal parts, shews us how much the twelve rods of water will gain by the year, which is upwards of 2*l.* 13*s.* a year, which is very profitable.

Now, if you will suffer your pond to breed, then it may be sloped on the side, and may save you the expence of boarding it: but whether it be done the one way or the other, if the river runs through it, you may have cray-fish in it, which is yet an improvement. If it is boarded on the sides, then there must be some holes left in the boards for the cray-fish to lodge themselves in the sides of the banks, for there is their residence; but if the banks are sloped, then it is so much the better, and the crayfish will increase the more, as we may observe in those rivers where cray-fish are the most frequent. If they should happen to breed in your canal, they will be very numerous in a little time; and if they are agreeable to you, either for your own eating, or to dispose of otherwise, you will find an extraordinary advantage from them; they will thrive well in any trout-river: their common price about *London* is 8*s.* per hundred, which will surely make your canal worth 4*l.* a year, or more money, if you mind to supply it with young when you take away the old fish, or take care that your water is not over-stocked.

Upon this water you may likewise keep six couple of ducks, which for laying early and bringing forward increase,

increase, should be of the hooked-bill sort, and from that kind a person might have young ones fit for killing about the latter end of *March*, as I have seen this year sold in the *London*-poulterers shops for 2s. apiece; but supposing every one of the young they produce, worth 1s. at the first hand, I think one can hardly reckon less than 40s. for the increase of six couple of ducks, deducting all hazards, and expence of feeding them.

Now I suppose that those which you keep till they are full grown, will not be of less value to you, because (as you will have a warren, and many offals, besides the entrails of rabbits) there will be no great quantity of food to be bought in for them.

But as I have now done with your canal, I shall in the next place give you my thoughts concerning your other pond or moat, wherein you propose to keep pikes or jacks. I suppose I need not tell you, that they are the most voracious fish that the fresh waters produce, even so greedy as to prey upon one another. If the water-toad or frog should in that pond chuse their habitation, the jack will be sure to fill his belly, and yet the flesh is never the worse for that: the fish which only can keep him company without danger, are eels, flounders, and the perch; the two first are as voracious as himself, and have a constant guard over themselves; for their abode is always in the mud, leaving only an hole open at the top, through which they suck in their prey as it passes by.

Now the guard which eels and flounders have against this tyrant of the water, may reasonably lead you to make them inhabitants of the same pond; and if he should be hungry enough to attempt them, they have the mud at command against him, and it is well known the pike delights in clear waters.

The perch may likewise keep the pike company in a pond, for the sharp fins on a perch's back arms

him too well to invite the pike to attempt him; but wherever these fish are together, they should have reach and dace for their support, and some water-weeds should be planted for their shelter and nourishment; for where there are water-weeds, there will also be water-insects, which help to feed the fish. If your pike are large, take care of your young ducklings, for the pikes will prey upon them.

When your ponds are thus provided, you need not make a stew-pond for fish; for by feeding your fish daily, you will have them at your command at any time in this pond; likewise, if the river passes through it, I would advise you to put in some cray-fish; and as it is near as large as your canal, one may justly reckon it to be worth 3*l.* a year. I would certainly contrive to have the river run through both: besides I would have the benefit of the wheel, which need only be used now and then.

You may put into such a pond at the least about forty eels, and as many flounders, about ten brace of pikes, and as many perch; and your eels will never taste muddy.

As far as I am yet gone with your garden, it appears that about twenty-two rods of your ground turned into water, will afford you the following yearly profit, *viz.*

Your canal-fish, consisting of carp, tench, cray-fish, besides trouts and bream, is worth about,	—	—	—	—	—	—	—	—	4	0	0	
Your yearly benefit by ducks,	—	—	—	—	—	—	—	—	2	0	0	
Your yearly benefit from your moat, or other pond, by eels, pike, perch, flounders, and cray-fish, about,	—	—	—	—	—	—	—	—	3	0	0	
In all about,	—	—	—	—	—	—	—	—	£	9	0	0

Now

Now this, I think, is a very good return for so little ground; and there yet remains one hundred and thirty eight rods of ground from your acre to be improved otherwise.

I observed by the draught of your ground, that the orchard-trees take up about thirty-eight rods, or are so disposed, that such a quantity of ground will bear little else for profit; for the grass in such a spot, did it lie all together, would not be worth above 5s. a year at most, because of its rank and sour taste.

Let us suppose then, that in these thirty-eight rods of ground, there are as many trees that bear good sorts of apples and pears, as there are rods in measure; these trees, if they are well grown and in good order, as you seem to intimate, may, at a very low rate, be reckoned worth 5s. apiece each year, one with another; even as the case is now, where by injudicious management, they are so subject to fail. And this rate in general for all trees that are healthful, I think, is moderate enough; therefore if thirty-eight crowns, or 9l. 10s. be the gain of your orchard at this price, then from sixty rods out of your acre in water and orchard, you have 18l. 10s. a year.

But let us now examine the profit of the warren you design, which is to include four rods of ground; in that you may keep ten couples of does, and two buck-rabbits. The buck-rabbits must be chained in a covered place where the does come to feed; and you must by no means suffer a male-rabbit to live unchained, without it be castrated, for otherwise it will eat the young ones; and it is for that reason, that the doe-rabbits in wild warrens lay their young ones in by-places under ground, and cover them up until they can shift for themselves.

The castrating of the male-rabbits will moreover render their flesh as agreeable as that of the female, and they will be much larger and more tender.

84 A GENERAL TREATISE Part I.

The eleven couples, with their offspring, will eat about four quarters of bran in a year, £ s. d.
or forty-eight bushels, which at 9d. per bushel, comes to, — — — — 1 16 0

And twelve bushels of oats will be as much as is necessary for them in a year; which at the dearest rate, are but 16s. per quarter; so that the amount of oats is in a year, — 1 4 0

The hay which they may require will come to at most but six trusses, which at 1s. each, will make, — — — — — 0 6 0

Thus we find our yearly expence for the maintainance of the warren to be, — £ 3 6 0

The rude cabbage-leaves, the turnep-tops, the carrot-tops, and the weeds which too frequently annoy a garden, will make up to them what is necessary.

The twenty breeding does will, if they are well fed, bring at least six *litters* of young ones each every year; but some have about nine or ten broods of young rabbits in a year. Their way is, when a rabbit kindles, to leave only five young rabbits to each doe, and destroy the rest; for they reasonably judge, that more than that number will weaken a doe so much, that she will not breed so often as she should do for their interest. Now if your rabbits breed only six months in the year, which is the least that they will do, and that you was to save only five of a kindle to each doe, you would have in a year six hundred young rabbits; which, one with another, would sell for 6d. apiece at a month old, without consuming hardly any hay, bran or oats; so that then your warren would afford the value of 15l. a year.

Out

Out of which, if we take 3*l.* 6*s.* which is
the charge of their extraordinary food, *£ s. d.*
there will remain neat profit, — — 11 14 0
By which, with the profit arising from ducks,
fish, fruit, &c. you are a gainer, — — 30 4 0

And the entrails of the rabbits will always be of use to your fish, if you strew them in the water while they are fresh, otherwise the fish will not eat them. But we have yet remaining ninety-six rods of ground : you very well know that rabbits, when they are about three or four months old, are very large, especially the males that have been castrated ; and then they are worth more than I have put them at, as they feed upon extraordinary diet.

In what I have mentioned, I rated things at their lowest prices ; for were I to set them at a retailed price, they would come to near double the value.

When you build your warren, take care that the ground fall a little, and lie hollow in the middle, so that the rain may easily pass away, and that the floor may be washed, if there is occasion ; when this is done, pave it all over with brick or stone, and build your wall about it, a little more than three feet high ; and upon that place palisadoes. Then two feet and a half from the wall within-side, build walls of about a foot and a half high, leaving openings or holes wide enough for the rabbits to go in and out, at a foot distance from one another ; so you may have about twenty holes on a side ; for though you have but ten couples of does, the young ones must shift in cells of their own, when they are about five weeks old, if you keep them so long.

Between the holes you must put partitions of boards to separate the cells ; and let all these boards be of the same depth, because over them must be doors on hinges to lock down, as you think proper ; and over these doors likewise there must be a sort of roofing of
G 3 feather-

feather-edged boards, to lie sloping from the warren-wall, to the other, so as to carry off the wet; and these likewise should be made to open and shut at pleasure. We have then little more to do than to provide boards to let down before the holes, as occasion shall offer, to confine the rabbits in their cells, or to preserve them in the night from vermin.

But to explain the manner of the warren more fully, *a a a* *Plate II.* is the wall which encompasses it. *A A A* is the little wall or front of the cells on one side, in which are the openings or entrance into the cells. *B* is the roofing of feather-edged boards shut down over the cells, to preserve them from the wet. *C C*, the feather-edged boards, are opened to come at the doors over the cells, which should be kept locked. *D*, a place of shelter from the weather, wherein two buck-rabbits should be kept chained for the use of the does; and likewise under this place of shelter should be kept the meat of the rabbits, as dry as possible, but as light as can be: it may be made like an alcove; but every one, as their fancy leads them, may vary the figure. *E E E* shews where the lowest part of the pavement should be, or the gutter to drain the floor of the warren; which when it comes near the feeding-house, should turn off to the corners (*c*).

I shall

(*c*) The rabbit is distinguished into two kinds, the wild and the tame; these are kept in a distinct manner, the wild running loose, and burrowing themselves holes in the ground, and the tame being kept in houses, huts or boxes: the management of the tame rabbits, or those at least confined in houses, being that treated of by our author, we shall here only exhibit the directions proper for the management of the wild rabbits, or such as are suffered to live loose and at freedom.

The wild rabbits breed fastly and freely in warrens, or other places where there is room and a free air: they will thrive upon the poorest and barrenest soils, and in these grounds the farmer will find great advantage from the breeding

CHAP. OF H. SANDRIT
AND A. H. SANDRIT
AND A. H. SANDRIT
AND A. H. SANDRIT

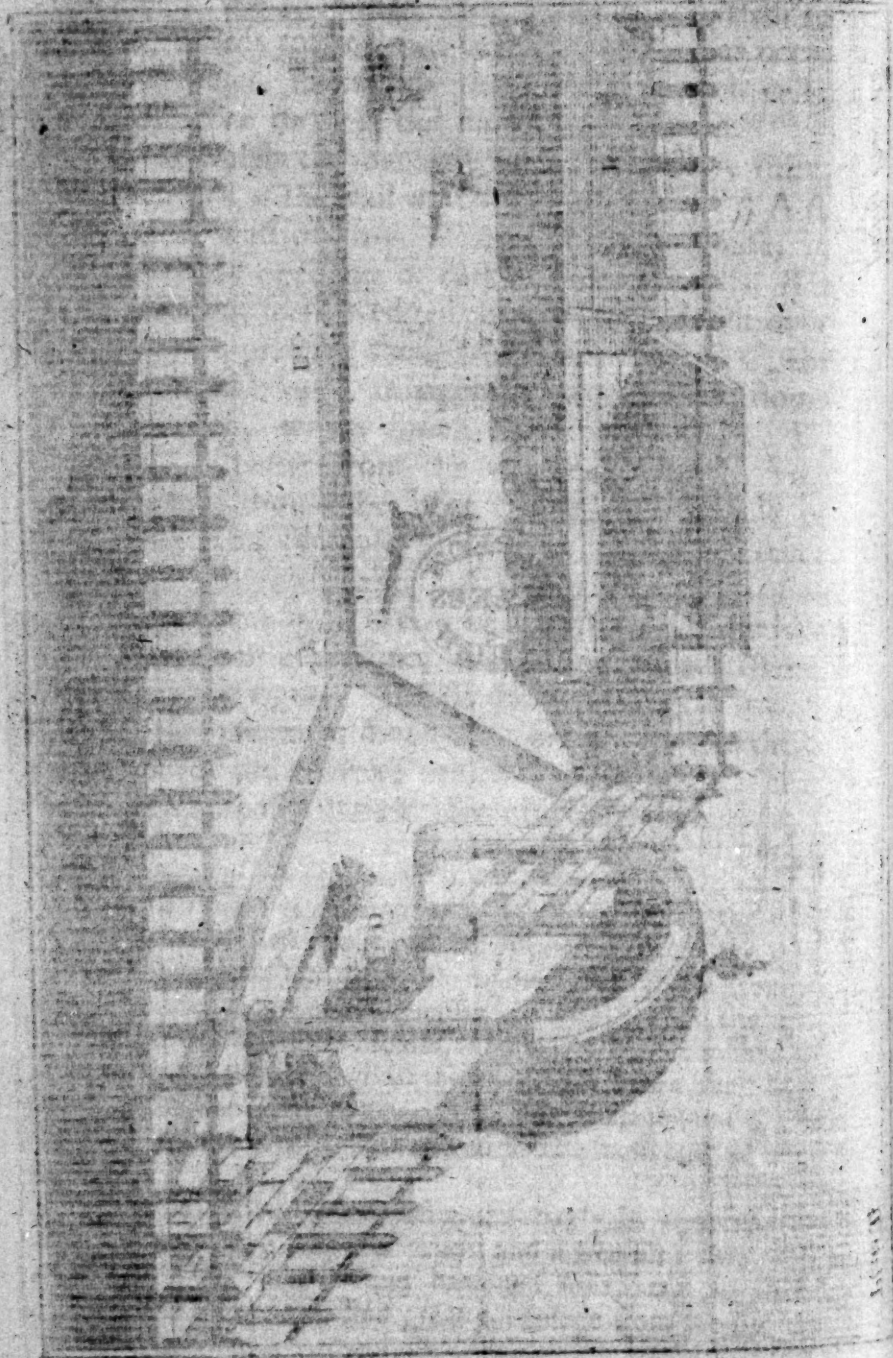
Facing Page 88

Plate II.



W. H. SANDRIT

THE GENERAL TREATY
BETWEEN THE UNITED STATES OF AMERICA
AND THE KINGDOM OF SPAIN
FOR THE CESSATION OF HOSTILITIES
AND THE RESTORATION OF PEACE



I shall in the next place suppose that ten clear rods of ground are employed between your barn and house, in the nature of a farm-yard, and in this you will keep your poultry; which in the spring, about breeding-time, may be about twelve hens and two cocks; six turkey-hens, and one cock; these, could they have a communication with your orchard, would save a third part of the food you must otherwise give them, if they were to run only in the farm-yard; about half a bushel of barley may do in a week for

G 4

such

ing of rabbits, as by their dung and urine they improve the barren lands extremely. A small number is sufficient to be first turned in; for of all creatures useful to mankind they are the greatest breeders. In general, the shorter and scantier the grass, the better is the taste of the rabbit. The drier the ground, the better they succeed, for where there is much water they never are so well flavoured. *Complete Body of Husbandry.*

In setting up a warren, great caution is to be used for the fixing upon a proper place, and a right situation. It should always be upon a small ascent, and exposed to the east, or the south. The soil that is most suitable is that which is sandy, for when the soil is clayey or tough, the rabbits find vastly greater difficulty in making their burrows, and never do them so well. All due precautions must be taken that the warren be so contrived that the rabbits may habituate themselves to it with ease. Many would have it that warrens should be enclosed with walls, but this is a very expensive method, and seems not necessary nor adviseable, for we find but very few that are so, and those do not succeed at all the better for it. Mr *Chamel's* opinion is, that it ought to be surrounded with a ditch. This indeed is no fence to prevent the rabbits from going out, unless there be water in it: but it marks the intended bounds of the warren, and the rabbits generally confine themselves within its circumference, though not necessarily compelled to do so. The space proper for a warren has no limits but the owner's pleasure, but in general the larger it is the more profitable it proves; and the rabbits, when once accustomed to the place, will keep within its bounds, though they are neither hemmed in with walls nor ditches, or any other fence whatsoever.

such a number of fowls for half a year, and a bushel a week, for the other half year.

Barley is about 14s. per quarter; so that then one half year will take thirteen bushels of $\text{£} s. d.$ barley; which at 14s. per quarter, comes to about, — — — — — 1 1 6

In this half year our chief profit is in eggs, which, I suppose may be worth about, — 0 5 0

But if we are fortunate enough to have some broods of chickens, which may be fit for killing, either about *Christmas*, or from that time until the end of *May*, the markets at first hand will value them at 1s. apiece, and to judge at the lowest rate, I think if we reckon twenty chickens of that kind, we are not much out of the way. The value then of eggs and chickens will be 1l. 5s. and I shall not suppose, that above three hens are employed in the breeding of these chickens. Then we have nine breeding hens for the benefit of the other half year.

Their waste eggs may be valued at 1l. which with their chickens, reckoning eight to $\text{£} s. d.$ every hen, one with another, at 6d. per chicken, comes to, — — — — — 2 16 0

To which if we add the former gain by early eggs and chickens, — — — — — 1 5 0

Our total amount in one year is, — — — — — $\text{£} 4 1 0$

But the price of the barley for one half year is, 1 1 6

The price of the barley for the other half year at a bushel per week, is, — — — — — 2 3 6

Expence then is, — — — — — $\text{£} 3 5 0$

Which 3l. 5s. being deducted from 4l. 1s. there remains neat profit 16s. which being added to the other profits by fish, rabbits, &c. makes 31l.

The

The turkeys, if they are well managed, may in eggs before they set, yield 10s. and out of six hens, reckoning all hazards, we may expect about eight young ones to be brought up by each hen; and as it is no extraordinary price to reckon them at 1s. 6d. apiece, one with another, then we have forty-eight young turkeys, which come to 3*l*. 12*s*.

Which with the 10s. for the turkey-eggs, $\text{£ } 1. 4.$ makes, — — — — — 4 2 0

To which add the 31*l*. gained as above, by rabbits, fish, &c. there will be clear profit, besides the stock, — — — — — 35 2 0

After this we find you have remaining eighty-seven rods of ground, still to be improved by gardening.

While I am upon the topic of country-advantages, I shall give you some memoranda relating to the curing of pork and bacon, which will admit of as much enquiry, and I think will be of as much use, as any thing I have treated of in this letter.

Some time ago, as I eat some pickled pork at the house of one of my correspondents, I found his method of curing it to be much superior to the common way; and I prevailed upon him to give me the following memoranda for curing it.

First, The hog must be full half a year, and at most no more than nine months old; for its flesh will then eat kindly, and take salt better than if it was older. *Secondly*, When we are disposed to fat a hog, besides his common meat, we must give him a quart or three pints each day of horse-beans; this we may continue for six or eight days before he is put up for fattening. *Thirdly*, When he is thus prepared for fattening, we are to take care that he never wants either meat or water, and that his sty is well bedded with clean straw, or pease-haulm; he will eat at first about three quarters of a peck of pease in a day, and decline in his eating as he grows fat; about two bushel and a half

half of pease, or three bushels at most, will bring him into good order for killing, without making him too fat. I find then that scalding is much better than singeing him, for by scalding, the pores of the skin are much more apt to receive the salt, than those of the singed hogs.

When this is done, let him hang up a day before you cut him out; and then sprinkle some common salt over the pieces, to draw out the fresh blood from the flesh; for by these means your pork will take salt the better, and keep the longer. And some will likewise take out the larger bones, which, they say, helps to preserve it; for it is about the bones that it first begins to grow musty, or receive a taint.

After this, we must provide half a peck of common salt, a quarter of a pound of salt-petre, one pint of petre-salt, and half a pound of coarse sugar. These quantities I use for a hog weighing about fourteen stone. These ingredients must be well mixed together over a fire in an iron-pan, and when they are very hot, salt the several pieces of pork with them, without grudging a little labour; for the harder you rub these salts upon them, the surer you are of success. I have known a little carelessness, in the rubbing on of these salts, to have spoiled a whole hog.

When you have done this, lay the pieces close together in glazed earthen-vessels, and cover them close during the first fortnight, except only at such times as they should be turned, and fresh rubbed with the salt, which ought to be every other day; and when you put them again into the earthen pans, observe that those pieces which before lay at the bottom, do now lie at the top, and so change them every time you take them out.

In ten days or a fortnight's time, some of the smallest pieces, if they do not feel hard to the touch, must have more salt rubbed upon them, and in three weeks time your pork will be fit for use.

If we did not change our pork in the time of its salting, as I have mentioned, we should find that those pieces which lay at the bottom would be fit for use, when those on the top would hardly be better than common pork, or perhaps not so good. Where this changing of the pieces has been neglected, I have known the receipt despised; for there was never any other but those pieces which were at the bottom, that answered the design of the receipt.

I remember once, by mistake, there were put in among the salts three quarters of a pound of brown sugar, instead of one quarter of a pound, and in the opinion of very good judges, the pork was better than any they had ever tasted in *England*. I think for the larger pieces, it renders them more tender.

Thus far are the memoranda concerning the curing of pork; and as I am upon the subject, I cannot help communicating to you the following letter from Mr *Warner*, of the method used by the people of *Hamburg* and *Westphalia*, for drying of bacon, in which practice chiefly the goodness of their bacon consists.

Friend Bradley,

Thy favour of the 30th ult. I received; in answer to which, I send thee the method used to cure bacon in and about *Hamburg* and *Westphalia*, which is after this manner: Families that kill one, two, or three hogs a year, have a closet in the garret joining to their chimney, made very tight and close, to contain smoke, in which they hang their bacon to dry out of the reach of the heat of the fire, that it may be gradually dried by the smoke only, and not by heat; the smoke is conveyed into the closet by a hole in the chimney near the floor, and a place made for an iron-stopper to be thrust into the funnel of the chimney about one foot above the hole, to stop the smoke from ascending up the chimney, and force it through
the

the hole into the closet. The smoke is carried off again by another hole in the funnel of the chimney above the said stopper, almost at the cieling, where it vents itself. The upper hole must not be too big, because the closet must be always full of smoke, and that from wood-fires; coal, turf, or peat-smoke, I apprehend will not do so well. The manner of salting is no other than as we salt meat in common; and sometimes they use our *Newcastle-salt*, *St Ubes*, or *Lisbon-salt*, or a salt that is made at *Nuremberg* (not so good as *Newcastle*) made from salt-springs; in those parts they do not salt their bacon or beef so much as we do in *England*, because the smoke helps the cure, as much as the salt; for I have observed, when dried flesh hath not hung long enough in the smoke, that it would be green within, whereas, if it had hung its time, it would have been red quite through; for as the smoke penetrates, it cures the flesh, and colours it red without any salt-petre, or any other art. As to the food of their swine, I saw no difference between it and ours here; and if any have the preference, I believe it is the *English*; and I think that our bacon would be full as good, if not better than the *Westphalia*, if cured alike.

I have now answered thy desire, and wish it may be approved by our bacon-makers; for the bacon in that case will not only be less salt, but it will relish better every way.

Thy Friend, JOHN WARNER.

There is one thing which I cannot help mentioning to you before I conclude this long letter, and that is the method of making the famous *Stilton*-cheese, which all that taste it allow to be superior to every other cheese, either of foreign or *English* make.

Take ten gallons of morning-milk, and five gallons of sweet cream, and beat them together; then put in as much boiling spring-water, as will make it warmer than

than milk from the cow ; when this is done, put in runnet made strong with large mace, and when it is come (or the milk is set in curd) break it as small as you would do for cheese-cakes ; and after that, salt it, and put it into the fat, and press it for two hours.

Then boil the whey, and when you have taken off the curd, put the cheese into the whey, and let it stand half an hour ; then put it in the press, and when you take it out, bind it up for the first fortnight in linen-rollers, and turn it upon boards for the first month twice a day.

In my next I shall give you an account of the profits you may expect from the remaining sixty rods of ground, which I design for a kitchen-garden.

I am SIR, Yours, &c.

R. BRADLEY.

CHAP. V. *Rules for methodizing and assorting a parcel of ground containing sixty rods, for the use of a family of seven or eight persons, or for providing a kitchen-garden with necessaries for twenty or thirty in family ; in a second letter to Mr A. B. to finish the improvement of one acre of ground ; with a particular account of the sure method of raising mushrooms as they do in France.*

SIR,

According to my promise I here send you an account of the advantage you may reap from the sixty rods of ground which I left undirected in my former letter, by disposing it after the manner of a kitchen-garden.

Among the many I have conversed with, of all nations and degrees, I find one humour generally prevail in point of gardening ; which is, that the more profitable a garden is, the more it is admired ;
and

and the end of making and keeping a garden, is, (besides the advantage it will bring to the master of it) the pleasure of having every fruit and herb brought fresh to his table.

In the course of my observations I have found this design carried to a great length in some few places; but on the other hand, great numbers have failed in the execution of this design, either by over-cropping their grounds, or by wrong proportioning their quantities of herbs or fruit; or by neglecting to contrive a due succession of their crops.

The over-cropping or stocking of a ground, in the first place, robs it of its strength; and where plants grow too close together, whether their roots or tops are to be eaten, they are always small and useless: the best seeds of cabbage-lettuce will produce plants of no value, if they want room; the seeds of the largest roots will produce nothing of moment, if they do not stand at a right distance one from another, which the hoes used in the gardens about *London*, will, in some measure, help to teach us. The blades of the hoes for turneps are about five or six inches wide, while those for onions are but two inches: but these instruments I chiefly mention, because they are seldom used in the countries remote from *London*; for when the first has gone through the plants, though the blade is but five or six inches wide, yet the turnep-plants remain generally about seven or eight inches asunder, from the irregular coming up of the seeds; and so the onions will, after hoeing, stand about four or five inches asunder, which is full near enough, if we expect to have them good, and well-rooted; and even at such a distance they will very well allow a good draught to be made, during the summer-season, which will still help the remaining plants to enlarge their roots. So cabbage-lettuce, to have them good, should stand a foot apart, if we plant four or five rows in a bed; but if they are planted in a single row,

row, we may set them nearer together; for every plant which we expect to bring a large head, must have room for the air to circulate freely round it; and if that is not allowed, the plants will never spread, but run upright, and their leaves will be watery and insipid.

The roots either of turneps or onions, which commonly apple above ground, are always larger, as they have more room and more air about them; and then the leaves are short, and the juices are employed principally in the roots. So in carrots and parsneps, though they run downwards into the ground, yet as their green tops spread more or less, their roots are smaller or larger.

The second mistake is the wrong proportioning the quantities of these esculent herbs and roots in a garden, by which means we super-abound in one thing, while we are in want of another; and this happens chiefly from our judging wrongly of the nature and design of the things we plant or sow, or of their use at the table, or the time which every sort will last good.

We are to consider, that pease will require more room than any other thing in a garden, considering their table-use; for the fruit of many plants must go to make a dish, and then a crop of pease seldom lasts longer good than three weeks or a month; but yet, because we must have many plants, we are not to crowd them close together, for then we shall have a smaller quantity of fruit; and besides, the first gathering, when the lines of plants are too close together, breaks and bruises the plants, so that they do not even bring a quarter-part of their crops to perfection. I have experienced, that ten rods of the ronceval, and *Dutch-admiral* pease, have yielded more fruit when their lines have been set wide enough asunder, and have been well sticked, than three times the quantity of ground has done, where the rows were as many

many more in number, and twice the quantity of seed put into each row: and besides, those that had room enough, have brought good pease for above ten weeks together, by being watered now and then, and the pease gathered carefully from them, without bruising the plants. But though we might reckon ten rods of such pease to be enough for a family, yet when we come to provide carrots, or such-like roots, two or three rods will prove much more advantageous than the ten rods of pease; for in the roots there is little or no waste, but there must be many plants of pease to yield as much profitable eating as one carrot or parsnep will do. I suppose a carrot-root that requires about eight inches square of ground, will fill the space of a pint; and the profitable part of the pease that require a yard square of ground to grow upon, will hardly be more than half as much, considering what air they must be allowed; and so every thing in a garden, according to the profitable or useful part of it, should be considered.

Again, we ought to know what herbs or roots are chiefly used or coveted in any family, and proportion our stock of every sort accordingly; for otherwise, though our garden be fully cropt, yet if the favourite herbs or roots are not in full quantity to the master's will, the blame will fall upon the gardener, and thus, much of the garden, though it be fully cropt, becomes useless. Therefore it would not be amiss for a gardener to enquire, at his first coming into a place, what herbs or roots will be chiefly expected or used in the family, that they may be the objects of his care. And this leads me to consider the neglecting to contrive a due succession of crops; for in that case we may lose half the profit of our ground, which ought never to lie idle; for, by good management, one acre may be rendered as profitable as four or five with injudicious management. Let us never be too late in preparing for our winter-standing crops, for
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we may lose a third or half part of our winter store in quantity, by a fortnight's neglect; besides the goodness of our crop will not bear any comparison with any crop which has had due time to strengthen itself. We should consider the nature of the plants we shall want; and when one sort begins to decay, turn up the ground afresh, and renew it with another sort of plant; considering at the same time, that one tribe of plants does not draw from the earth the same nourishment that another sort will do; and therefore always change the tribes, and the earth will have nourishment enough for all, regaining what strength she has lost by one sort, while she is distributing to the others. The sowing of pease, then turneps, and after that corn, is a proof that land will bear several crops, successively to good advantage, without manuring: but there are many more instances to prove, that the earth can never be rendered unprolific, unless she is constantly constrained to feed one kind of herb or plant.

After these hints I shall proceed to a more particular inquiry into the necessary furniture of a kitchen-garden, for about seven or eight in family; which is the proportion I chuse, for the sake of your extent of ground, and because there are more families in *England* of about that number than of any other. What I shall say upon this occasion, may likewise assist in the accounts I shall give hereafter of the profitable production of larger gardens: but I must give this caution with my calculations, that bad seasons, and other accidents, must be allowed for, because they may sometimes cross our expectations.

Sixty clear rods of ground is such a piece of land as will very well supply a family of about seven or eight persons with every thing necessary; the standing crops, or such herbs, roots, and plants, as are to remain for a long time in one place, should be in-

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cluded in such a parcel of ground as we design for hot-beds.

For the hot-bed ground we may allow four rods of land, after the rate of sixteen feet and a half square each rod. In this piece of ground, when it is fenced, we may employ four frames, with three lights apiece, for the production of our earliest cucumbers and melons, and for the raising our annual flowers, to be planted for ornaments in the borders among the fruit-trees. In this place, though we employ only four frames, yet we must set apart two rods, that we may have room to shift the frames or hot-beds, so as to preserve a succession of heat to the tender plants; and the other two rods will serve for one ridge of cucumbers, and two of melons, each ridge two rods long, and about five feet wide, including the alleys. If we have two ridges of melons of this length, we may have about sixteen holes of plants, and upon each hole, with good management, we may have three or four good melons at least; so that our crop may amount to about thirty brace, besides what we might expect from our forward beds.

The ridge of cucumbers will bring a plentiful second crop, that is to come in about the middle of May, when the first crop in the frames begins to decline; but for the three ridges we must have two dozen of glass-bells at least. At the back of the frames we might also have a few kidney-beans; but they must be well taken care of, lest they over-grow the cucumbers and melons. And upon the side of one of the beds, when it begins to cool, we may sow celery.

But besides the early and the second crop of cucumbers, we must provide some to succeed for the later months, and those must be sown in the natural ground. These are generally called picklers, and for that use should be gathered as soon as the fruit first appears. For this use I shall allow two rods of ground; but as

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this sowing is not to be made till near the beginning of *May*, we cannot propose to inter-plant the cucumber-boles with any thing, unless it be with cabbage-lettuce or radishes, which will be off before the cucumbers can hurt them.

The next spot I shall take notice of, is a piece of ground for pricking out of seedling-cabbages, favoys, cauliflower plants, celery, endive, &c. and for raising young salads upon: and for that use I allow three rods, which is sufficient for the plants that are necessary to be raised for such a family, till it is their time to be planted out at due distance for perfecting themselves. This parcel of ground will certainly contain a greater number of young plants, than can be planted out for good in such a garden as I mention; but as the expence of a little seed is no great matter, we shall gain this advantage by it, that we shall have enough to guard against hazards of weather, &c. and perhaps to oblige a neighbour.

We must also allot half a rod of ground, in some by-place, for a plantation of horse-radish, and another half-rod for a plantation of skerrets and eschalots.

The next parcel of ground must be appointed for twelve beds of pot-herbs, which (allowing five feet and a half for the breadth of each bed and ally) will take up four rods of ground, and should be planted thus, *viz.* two beds of mint, one of red-sage, one of sage of virtue, one of pennyroyal, one of hyssop, one of winter-favory, one of sweet-marjoram, one of burnet, one of clary, one of thyme, and one of parsley. I omit to mention borage, rosemary, angelica, and lavender for these beds, because borage will certainly find some place or other among the other crops, and rosemary will do well in by-places properly exposed, as angelica will fill some of the most shady corners; and for lavender, it will do best in an edging; and one may likewise have edgings of sorrel and of parsley; for we should sow parsley twice every year, and especially a

good crop against winter, when a large bed will afford but little. We may sow a line of marigolds in a spare or vacant place, rather than make a bed on purpose, because they do not last. I have allowed full ground enough in the above articles; and besides, as all men are not of the same taste, perhaps some of the herbs I mention may not be thought useful; if they are not, the ground may be planted or sown with other things. But it is very necessary however to plant our pot-herb garden as near the kitchen as possible.

We come in the next place to provide such a crop of asparagus as may sufficiently supply a family of seven persons, so as to have a good quantity every day, from *April*, that they begin to come up, till *June*, that we must leave off cutting them. I reckon that little more than three rods of ground will be sufficient; that is, four beds each of thirty-three feet long, and four feet broad, and the alleys two feet. These beds, when they are full crop, will afford us about seven or eight hundred of asparagus in a week, which, I suppose, will be enough for such a family as I mention; and they will last good about nine weeks.

But, besides these beds of asparagus for the spring-season, I allow three rods of ground, for seminaries and plantations of asparagus, for the use of hot-beds about *Christmas*, or in the winter-months.

The first year of planting the asparagus-beds, we are to sow the whole piece with onions, which will afford enough for a family of six persons for one year; we should not open the alleys till winter, and then the earth taken out of them should be flung upon the beds.

If these beds lie all together, they should run north and south, because we should set a row of forward beans in each alley every winter. We must note also, that the first year, by sowing onions upon these beds,

we shall have three rods of ground to spare in the other part of the garden.

Another standing crop is our artichokes, for which I allow two rods of ground, wherein the lines are to be three feet asunder, and the plants in each line to stand about two feet apart; so that in such a spot of ground we shall have about one hundred plants; out of which we may expect as many good flowers, and about half as many tolerable ones, besides small flowers, which are excellent to eat fried, or even raw with pepper and salt. Between these rows of artichoke-plants, we may in the spring have a crop of spinach and radishes.

In the next place we are to allow two rods for raspberries, which should be planted in single lines rather than in beds: the lines should be four feet asunder, and the plants in each line about a foot; in which case they will bear better, and bring larger fruit. The lines of raspberries, at four feet distance, and a rod in length, will be ten in number; and between these lines we may have eight lines of coleworts, for the spring-service, when greens are scarce, which is chiefly occasioned by the turning up our ground in *February* for a fresh crop. But I come now to speak of crops which are of short duration, and must be renewed every year, and even some of them twice and three times a year; or at least must be so planted, as to follow one another in different seasons. I shall begin with the bean.

Besides what we have mentioned of beans to be planted in the asparagus-alleys, we must at least allot four rods more of ground for family-use; that is, three of them to be planted for summer crops, with the broad *Windsor*-bean, so as to make two distinct crops; the other rod, as well as those planted among the asparagus, must be for early spring-crops of the hotspur or *Spanish*-bean: and of these, besides what I have said of the planting them, and cutting them

down, to vary the times of their ripening, we may still gain a late crop, if we cut down a parcel of them after all the beans are gathered : from then they will spring from the root afresh, and bring us a middling crop late in the year.

Among my inquiries this year I have examined into the quantity of broad beans that a rod of ground will produce, planted with double lines a foot asunder, and the distance of two feet between the double lines. The bean plants are supposed to be six inches from one another.

In a rod of ground, at this rate, there will be seven double lines, or fourteen rows of beans ; each row of beans will contain about thirty-four plants, and a double row sixty-eight plants, which in a rod amounts to four hundred and seventy-six plants.

I have observed several parcels of beans this year, of the broad or *Windsor*-kind, and I find that they are very inconstant in their bearing, some plants bringing five and twenty cods, others eight or nine only : so that, were I to make a computation, I would suppose that every plant could hardly bear less than ten cods, reckoning one with another ; and in some of these cods it is not very rare to find three beans, though more generally two, but for the most part there is but one bean in a cod : however, to judge as low as possible, I shall only reckon that a plant will bring ten pure beans clear of the cods, though I have numbered above twenty blossoms upon a plant.

In the measure of the broad beans, when they are taken out of the cods, I find that fifty beans fill a *Winchester*-pint strike-measure ; so that then we may expect from a rod thus planted, about forty-seven quarts of beans strike-measure, or somewhat less than ten gallons heaped measure. We may remark, that if we were to set the beans nearer together, they would bear less fruit : however, at the rate I set down, we may suppose that three rods will produce about thirty
gallons

gallons of broad beans, clear of their shells; but this must be while they are fit for eating, for when they dry, they will lose above two third parts of their measure; that is, a *Winchester*-pint, strike-measure, will hold about one hundred and fifty beans, so that a rod will take about three pints of dry beans to plant it.

The *Spanish* bean is of a much smaller kind than the former: but it is so great a bearer, as to bring, on every plant, twice the number of beans generally found on the *Windsor*-kind. One of the *Spanish*-beans is about one third part as big as a *Windsor*-bean; so that I compute, that a rod of the *Spanish*-bean, will yield about six gallons, or about two third parts as much in measure, as a rod of ground, planted with *Windsor*-beans; and those among the asparagus-beds, will yield as many more, because these plants have more air. Thus we may compute the whole to amount to about twelve gallons, which will very well afford us a good part of sixty days diet, besides some dishes from after-crops: While we have these in use, let us spare those roots and herbs which will hold good in that season.

I have observed in my introduction to this letter, that the pea requires more room than any other thing in a garden, and have given some reasons why it does so; therefore I allow in this garden, eight rods of ground for pease, besides the advantage we may have of shifting the pease in the ground I allow for carrots; which is three rods, so as to set an early crop of pease upon it; for the carrots must be taken out of the ground when they have done growing, and laid by in dry sand. Thus then we shall have eleven rods of ground for pease, besides a row, if we please, close under a south wall to be sticked up: Though they will not rise very high, yet they will bear better, and ripen sooner, than if they were to lie upon the ground.

But suppose we begin with the carrot-piece, for an early crop of pease; sow the lines double and the

pease four or five inches apart, and the lines about ten inches asunder to be staked up; but the alleys between the double lines, must be about two feet wide, so that we may have six double rows in a rod, or in three rods about eighteen double rows, or sixteen feet and a half long. Now were all these pease to stand the weather, which is very doubtful, if we put them in before the end of *November*, then there would be about one hundred plants in a double row; and a single plant of this sort will bear, if it be staked up, about twenty cods, which will carry from about five to seven pease apiece, and those pease, when they

are about the bigness of the following letter **O**, will fill a strike-quarter of a pint, wine-measure, from one hundred cods: that is a pint from four hundred cods, or a quart from eight hundred cods; so that we must have forty plants, to produce a quart of pease for the table, of the bigness I mention; or if we allow for hazards, and suppose fifty plants to yield a quart, then a double row of plants will yield about two quarts; and the three rods of pease, or the eighteen double rows, will yield thirty-six quarts, or nine gallons, strike wine-measure: but if we measure them by the heaped *Winchester*-quart, and allow for the loss of those which will grow too old for eating green, we cannot well reckon above five gallons of clear green pease for the use of the table; so that we may have about a dozen or fifteen good dishes of pease from this parcel.

The other ground that we allot for pease, which is eight rods, should be divided into three parcels, viz. three rods for the sugar-pea, to be sown in *February*, after the manner of the former, which will follow the earliest crop in ripening, and yield about five gallons of clear pease, *Winchester*-measure, besides several quarts for seed or winter use; though it is customary to sow them in single rows, and then the alleys be-

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tween the lines, must be about two feet and a half asunder.

We are next to sow three rods of large pease, such as the *Spanish-mooretto*, or the *rounceval* or *Dutch-admirals*. These must be planted in double rows in *April*, the lines of pease to be a foot apart; and we must allow half a foot on the outside of every double line, to place our stakes, which stakes must be bushy, such as the boughs that are generally cut for bavins, called brush-wood. The stakes ought to be full seven feet long, so that they be allowed above half a foot in the ground, and that the two lines be tied together on the top, so as to be full six feet high. The figure of this staking, at the ends of every double row, will almost represent the letter [V] reversed, and every double row of stakes will measure near two feet at the bottom. Between every two double rows of stakes, we must leave a passage of four feet wide, so that then there will be about six feet from the outside of the first double row, to the second double row. Then in three rods we may have five double rows of these pease about thirty-three feet long each. By this means, if they are staked early enough, and watered in a dry time, and, above all, carefully gathered; or, as I used to direct, the pease cut off with scissars; then, in this case, they will last bearing a long time, and produce near twice as many pease, as those that are ordered the common way. About fifty cods will yield of clear pease, as many as will fill a quarter of a pint, strike wine-measure; or four hundred cods will yield a good wine-quart: and a plant preserved in health, will bear about thirty cods: but supposing them to bear only twenty cods apiece, then a double row of thirty-three feet long, allowing the pease to stand at least six inches apart, will yield, when they are taken out of the shells or cods, about seven or eight quarts, and the whole about thirty-five quarts, or somewhat more than nine gallons, strike wine-measure,

sure, or for eating green, about six gallons, *Winchester*-measure.

There remains yet two rods to be sown with the same sort of pea in *May*, for a late crop, which will afford us above four gallons of clear pease, *Winchester*-measure: so that the produce of eleven rods of pease, thus ordered, will be about twenty-one gallons of clear green pease for eating, besides a good quantity for seed. Such a quantity may serve to afford us at least fifty large messes, to be gathered between *May* and the end of *September*: and if there should be more than we can dispense with while they are green, we may use them dry in the winter, for boiling; and the rounceval-pea especially is extremely good. It would be well to plant one rod of this piece, with the sort of pea which is common in *Holland*, called the gourmand, or glutton-pea, which the people eat shells and all, as we do kidney-beans.

Though I allow but two rods of ground for kidney-beans, we are to understand, that they will afford as much profitable fruit, as four rods of broad-beans, for in these there is no waste; and from the time of the first crop's beginning to bear, about the middle of *June*, they continue good until the end of *September*, with a little care.

In setting of these, the lines should be single, and about three feet distant from each other, whether they run up sticks, or are of the new dwarf sort, which does not climb at all; for they will spread more than a foot and a half, and therefore should be set about six or eight inches asunder in the lines, and have liberty to spread in the alleys: besides, room must be left sufficient to walk between the rows. We may set a rod of each sort, one in *April*, and the other in *May*, especially of the climbing sort, the latest of the two; for the dwarf-sort is the most hardy, and bears very plentifully. If they are well managed, we may reasonably expect from the two rods, above three bushels of beans
fit

fit for eating, and they will be an agreeable change among the summer-crops.

I allow two rods of ground for cauli-flowers, which we must plant about three feet asunder, that they may spread their leaves, and bring large flowers, which they will not do if they stand close together: so in the two rods to be planted three feet asunder, we shall have about sixty plants, or about ten every week, while they last. Note, that these two rods are for the spring-crop, to serve part of *May* and *June*; and when they are off, the same ground may serve to plant out our celery for blanching. The rows for celery must be better than two feet apart, and the plants six inches asunder: from whence we may draw celery from *August* until *February*. Or if we think that this spot of celery will be too much, plant part of it with endive for blanching; but if we use it stewed at the table, or in soup, we must find some other spot to plant more of it; for these ways of using it, destroy a great deal.

I reckon there cannot well be less than three rods of ground employed for cabbages, and especially if we have a little warren of that sort mentioned in my former remarks. The cabbage-plants standing at two feet distance, will give us about twenty rows of sixteen feet and a half long, or one hundred and eighty plants; which, besides the regular cabbages they will produce, will furnish us with a large store of young sprouts, even exceeding the cabbages themselves in goodness.

I also allow two rods of ground for broccoli, which being planted at about a foot distance from one another, this spot of ground will carry about two hundred and fifty plants, whose office being chiefly to sprout, the plants do not require to stand at so great distance as the cabbages. It is the flower-stalks of this broccoli that are used at the table. They must be taken just when they are shooting to blossom, and the

the outer coat or skin of them pilled off; they boil in about three or four minutes, and eat as well as asparagus.

Though we are provided with three rods of cabbages, we may yet allow two rods of ground for favoys; which in the winter, and towards the spring, will afford us a very agreeable variety. These must be planted at the same distance as cabbages, and then the two rods will bear about one hundred and twenty plants, the offal of which will help to feed our warren. When we plant our ground for cabbages and favoys, we might sow it with spinach and radishes, which would be fit for the table, before the plants began to spread.

The ground I allow for carrots is three rods. Such a piece of ground will afford us a large quantity of roots, either to be drawn in the summer, or for winter-use, and in them there is no waste; for what we can spare, the hogs will eat, and the green tops will be of service to the rabbits. And thus in one shape or other, they will all come to the table. These, if they stand at a right distance, will be in number about four hundred upon a rod, or about one thousand two hundred upon three rods of ground. Besides, we may sow with them some sorts of cabbage-lettuce, which will be fit to eat before the carrots begin to grow large; and which will boil excellently well. Upon this piece of ground, when the carrots are off, it is, that I have proposed sowing our early crop of pease; and if we were to suppose this piece for carrots to bring only a thousand roots, they will last a family of six or seven persons very well for six months, to be dressed every day.

The ground for parsneps, two rods. This ground must be sown when we sow our carrots; but the root must not be taken up until *November*, and then it is to be laid in the house. We may have about six hundred roots in the two rods, if the seed be good; and if they

they are more than we can use in the kitchen, our swine will feed extremely well upon them.

Three rods of ground, well planted with potatoes, will yield us about six bushels of roots; but we must not expect any other crop upon it while the potatoes are growing. Such land as is esteemed the worst, will do well for these roots: and considering how much profit they bring to a family, I wonder they are not more generally propagated in the poorer parts of our country.

Ground for onions, three rods. These three rods may be employed the first year of making our garden for a crop of pease for seed, or for boiling in the winter; for the first year, we shall have a sufficient quantity of onions upon our asparagus-beds. This piece being employed for pease, will yield in a summer about five gallons of clear pease, after they are threshed; and when it is used for onions, it will bring about three bushels in a summer. But in this, as in other parcels of ground, which I have marked, we must take care, that every crop we sow in it, be of a different tribe from what has been before, and thus shift the crops on each spot of ground every year.

I allow two rods of ground for a summer-crop of turneps; for though our garden will be well stored in summer with many varieties, we should by no means be without some turneps, to change now and then with our other garden-dishes. They will, moreover, be a good help to our warren, and their offals will likewise assist to feed our swine, so that nothing will be lost. These turneps will stand at about the same distance as the parsneps; so that in the two rods, we may reckon about five or six hundred roots. When the turneps are off, this piece may be sown with spinach for winter.

Having taken a view of the principal crops to be raised in this parcel of ground, we must observe, that as soon as any of them are off about *July*, we should then

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then provide for the winter, carrots, spinach, and such other crops as we may chiefly desire: and if we should happen to have more ground vacant than we can well crop at this season, it should be trenched up, to lie open during the winter, for spring-service.

From what has here been said, I suppose, it will be not difficult for any one to judge of the product of any quantity of ground, and to direct how much of each sort of herb, plant, or root, should be raised in a year for the use of a family of six, ten, twenty, or any greater number of persons: and besides, we may yet expect no small benefit from some fruits which may be trained in espaliers, and from gooseberries and currans, which may be planted in proper places in the same garden; but we must always remember to place such plants at a good distance from one another, so as to have the air and sun free and open where we raise any of the herbs or roots which we sow annually, otherwise they will run upright, and never set to any substance (a).

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(a) There are certain general rules always to be observed in the making this useful sort of garden called a kitchen-garden, which will render it much cheaper and more convenient than if undertaken at a venture without the consideration of them. It should always be placed behind a house, that it may be both sheltered and kept out of sight, and always should be as near as may be to the stables, that the dung may be ready, and cost no great labour nor expence in carriage. A square is the best figure for the ground; but this is not necessary, since all irregularities may be hid by the quarters. The soil must neither be very wet nor very dry, nor too stiff; and if there are any risings in any part of the ground, they are by no means to be levelled, as they will be of great use for different crops of several things. It must be fully exposed to the sun, and by no means overshadowed by trees. The quantity of ground is to be wholly proportioned to the size of the family it is to supply; for a small one, an acre of ground will be enough, and there seldom requires more than three or four acres. It should be walled all round with

I cannot well conclude this letter, without putting you in mind, that in *August* and *September* it will be a proper time for you to examine the fields for mushroom-rooms,

with walls twelve feet high for the reception of fruit trees, and the ground should be ploughed up three or four times before any thing is planted in it. If the soil be stiff, it must be manured with sea-coal ashes, the cleanings of the streets of large towns, or sea-sand, as also with rotten wood, and decayed and putrefied vegetables. On the contrary, if it be light, and warm, it must be manured with rotten neats dung; and if horse dung be used, it must be always very well rotted first. The soil must be at least two feet deep, and there must be a supply of water, which, if it can be contained in basons, or reservoirs, will be very convenient and advantageous. As soon as the walls are built, the first thing to be done is the laying out the borders under them, which should be ten or twelve feet broad; and on those which are exposed to the south, the early crops are to be planted, and the later on those to the north. No large or deep-rooting plants should ever be set near the roots of the wall-fruit trees, but the beans and peas, required to be early, should be planted in other parts of the garden, and sheltered by moveable reed-hedges, which will screen and forward them as well as the walls. The next thing to be done, is the laying out the ground into quarters. These should never be too small, but in a little garden it is better to have only a few of them. They must be surrounded with espaliers of fruit-trees, and have walks turfed between them, which in a small garden ought to be six feet wide, in a large one ten; and on each side the walk there should be allowed a border of three or four feet broad, between its edge and the espaliers. On these borders small salading, or any thing that does not remain long, nor root deep, is proper to be sown. If the walks are covered with lime, rubbish or sand, instead of being turfed, it will be an advantage to the fruit in the espaliers, though it takes off from the beauty of the garden. The best figure for the quarters is either a square, or an oblong; but when the nature of the ground does not admit this, they may be triangular, or of any other form. The ground in these quarters should never be sown, or occupied by the same crop, for two years together; and when any part of the ground is not used, it should

rooms, in order to provide yourself with that sort of earth which is found about their roots, and is full of fine white threads, and sometimes has little white knots appearing here and there in it; for this earth contains what is necessary for the production of mushrooms. The mushroom is so great a curiosity, and is so useful a plant in a garden, that I cannot help giving you the following account of the method of making beds for them.

The *French* way of making mushroom-beds, (I mean the method which is used about *Paris*, where we may continually find several acres of these beds) is to make each bed two different times, and to use only pure stone-horse dung; each parcel of which is to be tossed up fifteen days in a dry place before we use it, and kept during that time free from wet; which must unavoidably be observed, otherwise we cannot hope for good success: and there seems to be good reason for it; for by this making of the bed different times, it partakes of two different heats at the same time; the first part by that time it has been made fifteen days, begins to decline in its heat, and then the fresh dung coming to be laid upon it, increases in its heat as the first part declines, which affords us much such another changeable variety as

we should be trenched up in ridges, to receive the better the benefit of the dews. In one of the quarters which is nearest the stables, and is most defended from bad weather, should be the beds for cucumbers, melons, and other productions of the hot-bed; and it is a very good method to surround that part with a reed-hedge, which both shelters and hides the beds from sight. This square should always be large enough for the beds of two years. The most important points of culture and management are the well digging and manuring the soil, and the giving a proper distance to each plant. The quarters and dunghills are both also to be kept clear of weeds, for if they are suffered to scatter their seeds on the dunghills, it is in vain to root them out of the garden, as they will be continually renewed from thence. *Miller.*

we find in the season, when mushrooms appear of their own accord; and it is such irregularity of season, that gives life to the seed or spawn of the mushroom already in the ground. It is to be observed likewise, that when the bed is quite made, we must not cover it above an inch thick with fine earth; for if it is more than that thickness, and the mushrooms chance to come up, they will be small and watery, especially if the earth be somewhat stiff; indeed if the earth be extream light and open, though it be laid a small matter thicker than an inch, it will not do much harm.

I have observed that the *French* gardeners, when they make beds every month, put pieces of the mushroom-earth, as large as walnuts, into the earth which covers the bed, just in the line where the two makings of the bed join; for it is in such a place that the mushroom-earth, *i. e.* that which is full of the little white strings and bulbs of the mushrooms, meets with the declining and increasing heat, which is so necessary to make them spread and grow; and moreover, the horse-litter which covers the bed, contributes to retain the vapour that rises from the bed, and resembles in some measure, what we call a fog; and besides, admits only a glimmering sun to reach the young buttons of the mushrooms; for too much sun dries these young mushrooms, and stops their growth, and too little, disposes them to rot; therefore it is necessary that the litter we cover our bed with, should be cleared from all dung, and be laid upon the bed very light and free. I am the more particular in these observations, because I am told that some beds have been made for the production of mushrooms after my directions, which wanted every one of the particulars I have reasoned upon here; and at last when it was found that no mushroom appeared, the fault was laid at my door. But besides these errors of making the beds at once, and with old dung; when I came

to see them, I found that they were made flat at top, which is a position that a mushroom does not like; it holds the water too much, and thereby becomes rotten; upon the side of a slope, as is the disposition of the bed I direct, is the situation it delights in. We ought also in two or three days after we have planted our bed with mushroom-earth, to be very careful to examine it day after day; for if a mushroom should come up, and rot upon the ground, it will breed maggots or worms, that will destroy all the young spawn or buttons in the ground, and then our labour is all lost; and besides, this examining our beds every day, will keep the litter light and open upon the beds, and so promote the mushroom's growth.

In examining the course of the mushroom-fibres, we shall find, at proper distances, knots or knobs joining to the strings of the roots, each knot about the bigness of a pin's head, running just under the surface, in the manner of potatoe-roots; which knots in a few days, if the bed has any heat, will come to be mushrooms fit to gather; and we must by no means let any of them remain upon the bed after they begin to spread, or open their caps, for then they will breed worms that will destroy all the young ones; then in the gathering them, we should use no less care to take all the broken parts of the mushrooms away, and particularly every broken stalk, for these first are attacked by the worm; likewise when we gather them, or pull them out of the ground, if we find any small spawn about the roots, we are to separate it from the root, and plant it immediately in some part of the bed where there are the fewest mushrooms, using this spawn very gently, so as not to bruise it; and in a few days, in proportion to the heat of the bed, it will grow and produce mushrooms.

When we plant any of the mushroom-earth about autumn upon old decayed beds, I find it will be about
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ten or fifteen days before they appear; but if we find once that the roots spread, and begin to be full of knots, then we may break off some pieces of that earth, and plant them at a foot distance; and by such means, in a little time, the whole bed will be covered with them; after this manner from one single root, I have in about fifteen days time had a whole bed full, though the bed was quite without heat; but then it was at a season when they came up naturally; and when there is not such a season, we cannot hope for good success in planting them, without such another hot bed as I have directed (b).

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(b) In order to propagate mushrooms, the meadows and pastures should be searched for them in *August* and *September*; and wherever they are found, the ground should be opened all about the roots, where there will be found abundance of small white knobs. These are to be taken up with lumps of earth about them. Then some new horse-dung must be procured, and the litter being shaken out, the dung must be laid together on a heap to ferment for eight days. A trench must then be dug, and the dung laid in it a foot thick, and covered over six or eight inches thick with light rich earth; and into this, on each side, should be put in the knobs of mushroom-spawn, as it is called, at six inches distance. After this another layer of dung is to be made upon this earth, to six or eight inches thickness, or more, but observing to draw in the sides, so as not to cover the knobs of mushrooms above half an inch; then another layer of earth is to be laid on this, and some more knobs of the mushroom-spawn placed on this at the sides, as in the former; then put on a third layer of dung, drawing it still narrower, that it may not cover the second plantation; and cover this with another layer of earth, drawing this up into a ridge at the top, and planting more of the mushroom-spawn in it; but still laying it in sideways as before. When all is thus finished, the whole bed is to be covered half a foot thick with dry litter, to prevent the earth from drying too fast. When the bed has been made a fortnight, it should be carefully looked over, drawing away the litter with the hands, to see whether any young mushrooms appear; and they must be gathered as they grow large; for

From what I have here mentioned, it appears that the mushroom increases by the root, and may be transplanted as well as another plant; but whether it has seed or not (*c*), is yet a doubt among botanists. Before I conclude, I think it not improper to give you the following account concerning an improvement of the cabbage-plant.

As the blanching of herbs has been commonly practised in *Britain* for many years; it is to be wondered that no method has yet been taken among our famous gardeners, to accelerate the ripening or whitening of cabbages, especially as those which are forward in their growth, are so profitable in the markets, that one single cabbage will bring as much money, as four or five which come late in the year.

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if suffered to remain, they will rot upon the bed, and destroy all the young spawn that is about them. And when they begin to produce, the bed must be searched every other day all the year round, and every day in *August* and *September*, which is the time of their principal increase, to gather such as are fit for use. The manner of gathering them is, to pull them gently out of the ground, so that no part of their stalk may be left behind; but if any part of the spawn is pulled up with the stalk, that must be carefully returned into the bed. As the cold or wet weather comes on, the covering of dry litter over the whole bed must be increased. A bed thus managed, will remain good many-months, and produce vast abundance of mushrooms; and the spawn may be at times taken out from it to supply other new beds. At whatever time of the year this is taken up, it should be carefully laid up in some place till the month of *July* following, which is the proper time for planting it in new beds. *Miller.*

(*c*) Notwithstanding that the seeds of some species of mushrooms have been discovered since our author's time, the accurate *Buxbaum* is of opinion, that very many plants of this genus propagate themselves greatly by root, and are truly perennial; and this he supports by many solid arguments drawn from observations of the several species of mushrooms, or fungus, which are obvious and under the eye of every observer at many times of the year.

I am told, that it has been a practice for many years in some private gardens about *Worcestershire*, *Staffordshire*, &c. to fold up the leaves of coleworts or strong cabbage-plants, and to tie them together; by which means, in a fortnight's time, the inner parts will become white, and eat as well as any cabbage; my author practised this in his own garden with such good success, that from him several of the *London*-gardeners have fallen into the same method, and have reaped considerable sums of money by it.

In dry years, especially, this practice will turn to extraordinary account; for then our plants, though they come from the best seed, will be apt to run, or will make but thin and indifferent heads, but by this means there is not a leaf lost; and however the straggling leaves of the plants may be judged useless before they are tied up, they then become exceeding sweet and agreeable; however in the practice of this method, two things must be carefully regarded.

First, That the leaves of the plants we design to tie up, be very dry; for if there should be any dew or moisture upon them, they will rot and blight, when they come to be shut up from the air: And, *Secondly*, we must fold each leaf carefully over one another, in the exact order they grow, beginning at the center, until all the leaves are folded; and then bind them with bass cross-ways, from the top of the crown to the stalk, in such a manner as the leaves may not burst the bands, which they will be apt to do about a fortnight after they are tied; and indeed we should not do more plants in this way at one time, than we suppose we can use in about ten days after they are blanched, for they will grow unshapely, and lose of their sweetness; it is to be remarked, that as soon as we have tied up these plants, they should be well watered at the roots; that will fix the folded leaves in the order we have placed them, and accelerate their whitening, which at most will be in a

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fortnight.

fortnight. I think too, that by tying up some colewort-plants in the early season of the year, they would eat much better for being blanched, but that is according to a person's palate. I might have mentioned in my remarks on the dry seasons, that though few trees are blighted in the spring by scorching winds, or small insects, yet the herbage is generally very much annoyed by the caterpillar, which severely attacks the cabbages.

I am, SIR, Your humble Servant,

R. BRADLEY.

CHAP. VI. *Observations concerning sheep; and the methods to bring them artificially to rut, so that some sheep in every flock, may, in every month of the year, produce lambs; with an account of the method of suckling lambs in the house.*

THE observations which I have made concerning sheep, have given me many occasions of reflecting in a philosophical way, how far they may be improved: the use of this sort of cattle is very great, in our nation especially; their wool is of that service to us, that one may say, the greatest part of our people are employed or benefited by it; their flesh is, perhaps, as generally admired as any part of the *English* diet; their skins, fat, bones and entrails, are all valuable, nor is there scarce one part lost to the public.

We are told that we have now in *England* several kinds of sheep, which are generally distinguished by the coarseness or the fineness of their wool: some abound more than others in wool of a coarser sort, and some again are noted for carrying greater or lesser fleeces

fleece of either sort of wool, or in terms used by the husbandmen, are of a deeper or shallower staple. But whether the same breed of sheep may not produce a deeper or shallower staple, or finer or coarser wool, from the different food which several countries afford, I shall consider by and by.

Our countryman *Markham*, who in some things must be very just in his thoughts and observations concerning cattle, remarkably describes the difference which we should observe in distinguishing between the good and bad kind of sheep in *England*. He tells us, that if we would chuse such sheep as will bring a fine staple of wool, from whence may be drawn a thread as fine as silk, we must seek for them about *Leominster* in *Herefordshire*, and in some other parts of that county, and also in the parts of *Worcestershire* adjoining to *Shropshire*; yet these sheep, he observes, are of a very little bone, black faced, and bear a very little burden of wool. The sheep upon *Cotfald-hills* are of a better bone, shape and burden, but their staple or wool is coarser and deeper.

The sheep in the part of *Worcestershire*, which borders upon *Warwickshire*, and many parts of *Warwickshire*, all *Leicestershire*, *Buckinghamshire*, and part of *Northamptonshire*, and the part of *Nottinghamshire* likewise, which is exempt from the forest of *Sherwood*, are large boned sheep, of the best shape and deepest staple, chiefly if they are pastured; yet is their wool coarser than those of *Cotfald*.

The sheep which are esteemed the largest of all, are met with in the salt marshes of *Lincolnshire*, but these are not thought valuable for their wool; because their legs and bellies are long and naked, and their staple is coarser than all the rest.

The sheep in *Yorkshire*, and the more northern parts of *England*, are of a good big bone, but of a staple rough and hairy.

The *Welsh* sheep are the least profitable in wool of any other, but their mutton is sweet and delicate, though their size is small.

From some other curious observations of a great author, we might suppose that the fineness of the *Spanish* wool depends upon the kind of sheep in *Spain*; and he proposes for public benefit, that we should send to *Spain* for sheep. But it is beyond all doubt, that *Spain* had their sheep, which produce the wool that is so valuable, first from *England*. This author wonders that our sheep-masters have not procured some of those fine *Spanish* wooled sheep, supposing that for a time it would mend our wool, if not continue so for ever. He observes likewise, that the *Dutch*-sheep will ordinarily bring two or three lambs, and that *Turkey* sheep are very large with great tails; but that their wool is coarse, not only because of their coarse feeding, but on account that in hot countries they often copulate with the goats.

Now from these observations, and my own thoughts upon them, I shall draw some inferences which may perhaps be serviceable to a judicious farmer, or such sheep-masters especially, who know the profit of good wool.

We may gather from the remarks which have been mentioned, that the difference between the one and the other sort of sheep, consists in the largeness and smallness of their bodies, the largeness or smallness of their bones, the roughness or fineness of their wool, or the greater or lesser burden of wool they carry; and this we find happens more or less, as the sheep are fed in some places, after a different manner from what they are in others.

Let us then proceed to examine how nature acts in other cases; that is, how it happens that animals of various kinds, and plants of different sorts, are apt, now and then, though we still look into those of the same breed, to be bigger bodied than others; some have longer

longer hair, and perhaps very fine; others have it shorter, but very strong and hard: some small silkworms, though of the same kind, in common with the best, give us the same length of silk as the rest, but much finer, and therefore more valuable: some trees and plants though of the same species, alter so much, as to have their leaves, blossoms and fruit, of more or less luxuriant growth; sometimes so much as that one of the same sort shall not fill, either in leaf or branch, half so much quantity of space, or take up half so much room as another, although the figure and colours in all parts are the same. This, I think, depends either upon the quantity or quality of the nourishment every animal and every vegetable receives; if it is more, all the parts are more opened, distended, and more coarse or large to the sight; if the nourishment is less, the parts of those bodies are less filled or extended; and then they must be more minute and fine than the others, which receive a greater quantity of nourishment.

Thus all cattle, where they find grass or other food which yields them a natural plenty of nourishment without abatement, during the time of their growth, have their parts more fully expanded, and are of course much larger in bulk than those of the same breed, which are pinched in their diet, or have plenty of such food which is not agreeable to them; for one and the other are equally detrimental to them. Thus likewise, when cattle are come to the full extent of their growth, we may discern by their bulk, whether they have fed plentifully or sparingly, and consequently we may reasonably suppose that either their hair or wool, which are so many plants growing upon their bodies, will be more or less sizeable: if they are large in body they have had more juices to supply and nourish their hair or wool; and in such a case, their hair or wool will be stronger or coarser, and their flesh more spongy or less firm, than what we

we find in those of the same race which have fed on shorter or less luxuriant diet; for I observe, that such cattle, either sheep or kine, which have a short bite, or are sparingly dieted, have generally, if not always, finer coats than the former, for the reason I have given before. But we should observe likewise, that this full or scanty food must begin from their birth, and it is this I think that will make them larger or smaller boned, though they all come from the same stock. So the short bite of sheep upon some downs or heaths, or some herbs which they find there, may occasion their bodies to be small, and their wool fine; as on the contrary, rich land abounding in high grass, or the herbs naturally growing with such grass, may probably be the occasion of the large size of sheep feeding there, and of the coarseness of the wool; so likewise do these kinds of food bring the ewes to the rut sooner or later in the year: but were we to use art with the sheep upon this foundation, we might have them breeding any month in the year: this has been tried upon some creatures which never have been known to couple in our climate, and has had an immediate effect upon them.

In some part of *North Wales*, I am assured, that goats often couple with sheep, and therefore the wool is sometimes worse than it is elsewhere in *England*: but care should be taken, if possible, to prevent this: nor should we chuse our rams of these species which have horns, for their offspring endanger the ewes in yearning. The dodder-sheep are preferred by every shepherd of judgment, being good breeders with little hazard (a).

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(a) The sheep are a kind of cattle that is kept at the least expence of any to the farmer, and will thrive upon almost any ground; and for this reason many prefer them before the larger cattle. The best sort of sheep for fine wool, are those bred in *Hampshire* and *Worcestershire*, but they are small, and black faced, and bear but a small quantity. *Warwick*, *Leicestershire*,

Buckingham

There now remains a few observations concerning the breeding and suckling of lambs in the house. We are first to remark, that the ewes which are fed in some parts

Buckingham and *Northamptonshires*, breed a large-boned sheep, of the best shape, and deepest wool we have good. The marshes of *Lincolnshire* breed a very large kind of sheep, but their wool is not good, unless the breed be mended by bringing in sheep of other counties among them, which is a scheme of late very profitably followed there. The northern counties in general breed sheep with long, but hairy wool, and *Wales* bears a small hardy kind of sheep, which has the best tasted flesh, but the worst wool of all.

The farmer should always buy his sheep from a worse land than his own, and they should be big-boned, and have a long greasy wool, curling close and well. These sheep always breed the finest wool, and are also the most approved of by the butcher for sale in the market.

For the choice of sheep to breed, the ram must be young, and his skin of the same colour with his wool, for the lambs will be of the same colour with his skin; he should have a large body, a broad forehead, round and well rising, large eyes, and strait and short nostrils. The polled sheep, that is those that have no horns, are found to be the best breeders. The ewe should have a broad back, a large bending neck, small, but short, clean and nimble legs, and a thick deep wool covering her all over. Two years old is the best time for beginning to breed, and their first lambs should not be kept too long to weaken them by suckling. They will breed advantageously till they are seven years old. The difference of land makes a great difference in the sheep. The fat pastures breed straight tall sheep, and the barren hills and downs breed square short ones; woods and mountains breed tall and slender sheep, but the best of all are those bred upon new-ploughed and dry grounds. On the contrary, all wet and moist lands are bad for sheep, especially such as are subject to be overflowed and to have sand and dirt left on them.

As to the time of putting the rams to the ewes, the farmer must consider at what time of the spring his grass will be fit to maintain them and their lambs, and whether he has turneps to do it till the grass comes; for very often both the ewes and lambs are destroyed by the want of food; or if this does

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parts where there are invigorating herbs, go to rut or blossom in every month in the year, except *April, May,*
or

not happen, if the lambs are only stunted in their growth by it, it is an accident that they never recover. The ewe goes twenty weeks with lamb, and according to this it is easy to calculate the proper time. The best time for them to yearn is in *April*, unless the owner has very forward grass, or turneps, or the sheep are field-sheep, where you have not enclosures to keep them in, then it may be proper they should yearn in *January*, that the lambs may be strong by *May*-day, and be able to follow the dam over the fallows, and water-furrows; but then the lambs, that come so early, must have a great deal of care taken of them, and so indeed should all other lambs at their first falling, else, while they are weak, the crows and magpies will peck their eyes out.

When sheep are turned into fields of wheat or rye to feed, it must not be too rank at first, for if it be, it generally throws them into scourings. Ewes that are big should be kept but bare, for it is very dangerous to them to be fat at the time of their bringing forth their young. They may be well fed indeed, like cows, a fortnight beforehand, to put them in heart.

The best time for shearing of sheep is about the latter end of *June*, because it is good for them to sweat in the wool before it is cut; they must be very well washed before the shearing, for this is a great addition to the price of the wool; after the washing, let them go three or four days in a clean dry ground. When they are cut, the shearer must be very careful not to wound their skins, because this gives occasion to the flies to tease the poor creature in a terrible manner. Some shear their lambs, the first year especially, behind; but before the doing of this they ought to be carefully tagged, as it is called, that is, their tails and thighs behind should be well cleared of wool, that the dung may not hang there, which would else make them sore, and subject them to the flies, which would blow them, and make them full of maggots. In *Glocestershire* they house their sheep every night, and litter them with clean straw. Their dung makes this a very good manure for the land, and the wool of the sheep is rendered so much finer by it, that the farmers have a double advantage from the practice. In *Middlesex*, and about *London*, they have *Way-bill* sheep: these come from *Hampshire, Wiltshire, &c.* and lamb very early, before *Christmas*. *Mortimer*,

or the beginning of *June*. These herbs which are so invigorating and forcing to the spirits, are more particularly found in dry, than in wet places; and it is very certain that the use of them skilfully, would bring ewes to rut in *April* and *May*, so that every month in the year one might have some of his sheep produce lambs. In the mean time, I must acquaint the skilful farmer, that whatever ewes he finds most forward to rut in *December* or *January*, he must keep them from taking the rams, which every artful shepherd knows how to do.

But, however, concerning the suckling of lambs, it will be first proper that I explain some few terms which are necessary to be used, and which perhaps may not be understood in every county.

First, Bastard-ewes in *Surry*, are those ewes which suckle the lambs of other ewes, or have lost their own. *Secondly*, Bastard-lambs are such as have lost their dams, and suck upon other ewes. *Thirdly*, Tod-bellied, is when a lamb is thin-bellied like a greyhound, or clinged up. *Fourthly*, To suck at head, intimates a young lamb's sucking the first of the milk.

Now, with regard to the house for suckling of lambs, it ought to be divided into stalls, in order that every lamb may be the more conveniently suckled. Care ought to be taken that too many lambs are not put into one house at one time, lest they fall distempered, and become set or tod-bellied; to prevent which, also care must be taken that what milk the youngest lambs leave (if any) may be sucked by the oldest lambs.

If you have any bastard-ewes, suckle the eldest lambs, beginning about seven in the morning, and about four in the afternoon; and when the bastard-ewes have milk enough to suckle all your lambs thereon, then put in the dam only at noon, and between

tween nine and ten at night, and out again between nine and ten in the morning.

To avoid mistakes, which might happen in the suckling of many lambs, we must mark them, to know which has been longest in suck on the bastard-ewes, and those which have been long at suck, are to suck still at head.

As soon as possible, let your ewes-udders and tails be clipped from the wool, to keep them clean from the dirt they are apt to gather in the house.

When those which suck at head, on the bastard-ewes, have had their meal, put on those lambs which you design next to suck at head, to suck those ewes clean of their milk.

Observe if you have any twin-lambs, or dams that give little milk, to help them on the bastard-ewes.

Feed your lambs on flour, wheat or white pease in troughs, and with wheat-straw in racks, and sometimes fine hay, but straw is better for the colour of their flesh.

Before I conclude, I must take notice of a piece of foreign husbandry, of good use where it is practised, which regards the housing of sheep at night, and from whence we have taken the method of folding our sheep at nights for the benefit of land. In *Flanders*, and other parts of the continent, where the sheep are endangered by wolves, they are housed every evening, in places spread with clean sand, about five or six inches thick; which sand-floor, being every night renewed, occasions the whole to be taken away about once in a week, and is so rich, by the means of the dung and urine of the sheep, that it is purchased at great rates, and makes excellent manure for stubborn ground.

CHAP. VII. *Concerning the improvement of land by clover, with the method of gathering and dressing the seed.*

THE husbandry of clover has proved of great advantage to several parts of *England*, but is not yet so generally known, as to be cultivated in every place where it would prove beneficial. We have many lands in *England* which might be greatly improved by it, and I shall therefore be the more particular in my account of it.

We are first to understand, that clover has been, for many years, cultivated chiefly in *Flanders*, and has been but of late introduced in *England*; therefore it will be necessary to acquaint my reader, that the *Flanders-soil*, where this herb was mostly cultivated, is sandy light earth; for the most part, such as the heath-ground with us, and there it thrives very well, and returns more money to the farmer than three or four times the same quantity of land will bring by common grass.

It is of great use for feeding cattle, either in the green herb or in hay, and may be sown simply, or with oats, barley, or rye-grass, and either of these ways turns to extraordinary account. The seed alone brings considerable profit; but at present, in *England*, I find the art of threshing the seed and cleaning it, is so little understood, that we are forced to send to *Flanders* for the greatest part of what we use, and are very often deceived by it, because it is generally mixt with old clover, and therefore does not bring half a crop.

For that reason I shall begin with the gathering and threshing out the seed, that we may be at a greater certainty in our husbandry of this herb, and have the benefit

benefit of it among ourselves, without being obliged to a foreign nation, who may one time or other perhaps find an occasion to quarrel with us.

One of my correspondents, who signs himself *J. Hagar*, tells me, that in *England* an expert man can only thresh about half a peck of clover-seed, or at most a peck in a day, for want of the art which they have in *Flanders*, where twenty-five, and thirty pecks of seed are easily cleaned in a day by one man. In *Flanders* I have seen two or three ways of doing it by engines, after the heads of the seeds are threshed off with common flails: the engine which I best remember, has an hopper at the upper end of a trough, so that the heads of the seed fall continually from the hopper into the trough. The trough is about six feet long, and about two feet and a half over, and lies slope-wise from the hopper, which is at the higher end, so as to drop at the other end about a foot: the bottom of this trough, within side, is made rough by chissels, and upon that is a broad board, made to draw backwards and forwards, which is cut in a rough manner, like the inside of the bottom of the trough. When the heads of the seed fall into the trough at the upper end; the broad board in its motion draws them through the trough, and thereby breaks or opens the seed vessels, so that the chaff and the seed run out of the lower end ready for winnowing: this motion is maintained by a water-wheel and a crank, and answers very well the purpose it is designed for. I have seen an engine of this kind, where the bottom of the trough was an hurdle, more finely wrought than our common hurdles; and the sliding part, which I call the broad board, was an hurdle of the same make. In this I found, that most of the pure seed fell through the lower hurdle, and little more than chaff was discharged by the lower end of the trough, and consequently must give less trouble in the winnowing or cleaning from the chaff.

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I have seen also another kind of mill or engine for this purpose, which somewhat resembles the mill which tanners use to grind their bark. In the former I should have mentioned, that there is commonly a weight laid upon the upper hurdle or broad board, the better to break the heads of the seeds that pass between that and the bottom of the trough.

When we are thus provided with the seed, we are to chuse our ground; and from experience we find, that such as our common heath-land is very proper for it; that is, the seed will grow well there without much manure, and bring the farmer profit where he has had the least expectations: it is in short the adapting the proper plant to a proper soil, which promotes the husbandry that I would endeavour to recommend, and of which I have had long experience; but though this soil is good for clover, there are others that are light and sandy, or gravelly, or tending towards loam, which will produce it in good crops; but the last kind of soil will bear other things, and therefore I shall treat chiefly of heath-grounds, how they may be improved by it.

When therefore we have a parcel of heath-land before us, the heath-turf must be first turned off and laid in heaps, to be burnt for the manure of the same spot it was taken from: but a common plough is not proper to do this; for in tall heath, horses cannot, without much trouble, draw a plough: therefore it must be such a plough as is not drawn with any cattle.

For this purpose the breast-plough is most convenient, because it will open our land for other ploughing: but the turf which it turns up must be laid in heaps, to the proportion of one hill upon every rod of ground, or such a parcel of land as is sixteen feet and a half square; we are then to burn these heaps, and, after a few days, spread their ashes over the land, in order to be ploughed in.

The husbandmen in *Devonshire*, when they have reduced these heaps of turf to ashes, add to every hill about a peck of unslacked lime, which they cover over with the ashes, letting those hills remain until the rains fall upon them, and open the parts of the lime; after which they mix their ashes and lime together, and spread it over the land. For ploughing in this and the former case, be it which it will, the ground should not be turned up above four inches deep, lest the ashes alone, or the mixture of lime and ashes, should be buried beyond the reach of the roots of the clover, which does not strike its fibres very deep; and therefore the breast-plough may perhaps go deep enough for this purpose, but I believe it will save very little expence.

In the ploughing for this seed we must lay our land as level as possible, and sow the seed soon after the plough, harrowing it with bushes that are pressed with a convenient weight; and as a light land is chiefly desired for this seed, we should contrive to plough and sow the land soon after rain.

The seed-time or season for sowing this seed, is about *March* or *April*; and if we sow it simple, or without other grain, an acre will take up about ten or twelve pounds of seed, for the seed is small; but if we sow it mixed with barley, oats, or rye-grass, which last they call *ever*, or everlasting-grass, in the west of *England*, then about half the quantity is enough.

I have observed, that when it has been sown with barley, the crop of barley was very good, and there was a good crop of clover mown also the same year, after reaping of the barley; and after that, a plentiful grazing for cattle in the winter. The clover-plants in this case grow strong and vigorous; for when the barley is ripe, the roots of it draw no more nourishment from the clover, but decay, and rather assist it.

On the other hand, where it is sown with the grass called *ever*, it does not grow, by three parts in four, so strong as when it is sown with barley or oats; because the *ever-grass* is continually entangling its roots with it, and depriving the earth of its nourishing faculty, so that the clover gets its nourishment with difficulty, and it is very likely has not above a fourth part of the food that it requires.

If we make this clover a crop of itself, we shall find it more luxuriant than in either of the former cases; and it may then be cut three times in a year, and will leave a rich grass for winter to feed cattle. We may judge of the right time for cutting it, by examining when it begins to knot, and then we may surely go about the work.

Clover is a plant which will blossom and bring ripe seed the very year of sowing; but when we have a mind to save seed from it, we must cut our first crop in *June* (as I have said) as soon as the clover begins to knot or joint, and the crop following must be left for seed, because then our field of clover will, by means of the cutting, branch into more seed-bearing parts than it had before the cutting, and consequently will bring a greater quantity of seed. And again, we are to observe, that the year in which we design our clover for seed, we can only cut it twice, because of the time the seed takes to ripen: otherwise we may expect three crops from one piece of ground, as was said before, which makes excellent hay. When we save clover for seed, we must remember to let it stand till the seed is full ripe, and thresh off the heads to be opened by the mill I have mentioned. An acre will commonly afford five bushels of clean seed.

It is affirmed, that the long stalks which remain after threshing, are nourishing food for cattle; and even when they grow dry and hard, we may boil them, and they will make good mash, which will be profitable to hogs.

This herb is not long before it springs, though it be close cut; and when the last cutting, every summer, either for hay or seed, is over, we may turn in cattle upon it, lest it grow too rank to bear the winter. It has been observed by some, that one acre of clover, well managed, will feed as many cows as six acres of common grass, and make the milk much richer, besides keeping the cows deep in milk; or, in other terms, making the cows give more milk at a meal than common grass.

But where this clover is not common enough to afford us sufficient pasture for our cows in the winter, we may partly make amends for the want of it, by feeding them with grains, which are left of the brewing of malt, and good barley-straw. This food, if it is given them discreetly, makes them yield a great deal of milk of good quality; but especially I observe, that the barley or oat-straw, which is mixed with clover, is preferable to any straw that has not clover with it. This mixture adds greatly to the benefit of the cattle that feed upon it.

A field of clover will last in good strength about five or six years, according as the soil is more or less agreeable to it. And when we find it begins to decay, I am told, that upon being ploughed up, it will yield good wheat for two or three years, and after that a good crop of oats, without any manure; for clover meliorates the ground for corn, or at least does not draw any nourishment from the ground, which is necessary for the good growth of corn: it is by every body held rather to be a manure for corn, and that its parts, which become rotten in the ground by ploughing, yield such salts as are of service to the vegetation of it, but of wheat especially.

Some tell us, after we have had corn two or three years upon a clover-ground that has been broken up, and have, the fourth year, sown that ground with oats, that we may, when the oats are just come up,

sow the same ground again with clover-seed; and that when the oats are cut, we shall find a good crop of clover at the bottom. At this sowing there is no need of covering the clover-seed, for it is so ready to vegetate, that it will find its way into the ground, as we may observe of many other seeds of the like nature, which will bury themselves in the earth they are laid upon, without help. Upon this new clover we may begin to graze our cattle soon after the oats are off, and so continue until the following spring, when we must fence it for mowing; and that summer we may expect three crops in one year, as already mentioned (a).

It

(a) There are several kinds of clover, but the great sort is esteemed the best, whose seed is like that of mustard, except that it is more oblong. The *English* seed is preferable to that of all other places, and the farmer should chuse such as is of a greenish colour with a cast of red; that which is black never growing so well. It delights most in a rich, warm soil, and always thrives best in those lands which have been well dunged or manured; but the clay-lands which are long in acquiring a coat of grass (or swarding, as the farmer expresses it) and are little subject to weeds, are of all others the best land for clover; because in those lands where the common grass grows speedily it soon eats out the clover. Light lands are in general more subject to this sudden growth of common grass, and they have also another disadvantage in regard to the clover, which is, that they easily wash away from its roots after sharp rains; and then the roots, being left bare, are killed by the first frost that comes. In good grounds it will bear crops for three or four years; but not longer than that, even in the most proper soil, and with all the necessary cautions. There is a very easy method of determining what is good clover-seed and what bad; it is only necessary to throw it into a glass of water, and that which sinks is good, what swims is bad, and will never vegetate. It is easy, from this trial, to know what seed is to be depended upon, and what is not; and to know what allowance is to be made in bad seeds, for the quantity lost in the proportion for every acre.

Now it remains only that I inform my reader, that the clover I have mentioned in this treatise is the great clover, which was first brought to us, and still is imported by some people in seed from *Flanders*.

C H A P.

The best way of sowing clover is, either with barley or oats, after the corn is sown; and, upon this account, the corn is to be sown somewhat thinner than ordinary. The usual time of sowing it, is in the end of *March*, or the beginning of *April*, in a calm day; but if the land be very dry, it is better to sow it with black oats, as early in the spring as may be, that so it may get up while the spring rains last, and be of some strength before the dry weather comes. Some sow it with wheat or rye at *Michaelmas*; this gives it an opportunity of shedding its seed on the ground, and by that means, the crop of the next year is rendered much stronger than it would have been made by any other means; but then it is best to be sown upon dry lands, which will bear the sowing both of the wheat and the rye upon broad ridges; which is usually very successful, if a mild winter follows; but if there are long and severe frosts, or deep snows, it is very hazardous. Some advise the sowing it alone, at *Michaelmas*; which they say makes it come up the freer from weeds, than if sown in the spring; and that it will get strength enough before winter, to support itself against the frosts, and will grow finely in the ensuing spring.

Some farmers sow rye-grass with the corn at *Michaelmas*, and early in the spring they sow clover, which they only cover by rolling it. The best management of all seems to be the feeding it bare before winter comes on, and then it is safe; for the frosts, though they often destroy the leaves of the clover, yet never hurt its roots, unless they happen to lie bare. About the middle of *May*, or at the utmost toward the end of that month, is the time of mowing the clover for the first crop. This takes up more time and labour in the making into hay, than the common grass, and must be well attended; but if it grow not too strong, it will be found exceeding rich for the fattening of cattle. The exact time for the cutting this first crop is when it begins to knot, and after this some mow two other crops before winter. Hop-clover is the farmers name for the smaller species of clover, or three-

CHAP. VIII. *Of improving land by beans and pease. Observations concerning the improvement of beans and pease, in a letter to Mr R. Trotter.*

S I R,

YOUR great curiosity in husbandry gives me an opportunity of communicating to you some thoughts and experiments, which will be of great advantage to those who cultivate beans and pease, either for seed or otherwise.

First,

three-leaved grass, which they sow in many places instead of the large clover: it is esteemed much finer and sweeter than the large clover. If the cattle are to be turned in to feed at large upon it, this must be done gradually, and with great caution; for if they are at once removed from common grass into this, they will over-feed upon it, and even burst themselves; they are therefore to be put in at first only for half an hour in the middle of the day; a second day they may be left in an hour; and the third day two or three hours; and after this, for three or four days, they are to be turned in as soon as the morning dews are off the ground, and driven out again before the evening dews fall. After this, it may be safe to let them remain in it entirely. Clover is apt to do harm to milch cows, more than to any other cattle; and it is a very good method some have, to take off from the too great richness of the crop, by sowing rye-grass among the clover. This upright grass grows well among the branches of the clover, shooting up its stalks above it, and being eaten with the clover, takes off from its too great richness, at the same time that it makes the crop the larger. The clover that is intended for seed is preserved dry all the winter, and in *March* it is to be threshed for the seed: what seed first comes out is to be cleaned from the straw, and the husks then are to be threshed again. When all is obtained that can at one time, let the straw be well dried in the sun, and tossed about with a rake, and then on the threshing it again, more seed in confi-

derable

First, It is a common custom amongst the farmers, when they are once provided with any sort of seed, to sow the same sort continually upon their farms, and thereby render it, in course of time, quite unprofitable; for where any sort of seed, though never so good at first, when it is brought into a country, has been cultivated for three or four years successively in the same air and situation, even if that spot of land be varied from acre to acre, or those grounds enriched from time to time with manures; yet experience shews us, that such seed will degenerate, and lose its first excellence; so that, when we once become masters of a good sort of seed, we should at least put it into two or three hands, where the soils and situations are as different as possible; and every year the parties should change with one another; by which means I find the goodness of the seed will be maintained for several years. For want of this use, many farmers have failed in their crops, and been great losers.

Secondly, It has been a great neglect, that our farmers have not been curious enough to inquire into several sorts of beans and pease, which kinds of them produce

derable quantity will be obtained: two bushels of seed may thus be procured, out of the produce of an acre of good land where the clover has throve. *Mortimer.*

In a dry summer, both sorts of clover are apt to miss growing, and if it does grow, and the next summer (wherein it ought to be a crop) prove very dry, it fails on most sorts of land: at least it is but of very short duration, and therefore is not to be depended on by the farmer for maintaining his cattle, which the broad clover will also kill, sometimes by causing them to swell, unless great care be taken to prevent it. The broad-clover is esteemed a foul feed for horses. The hop-clover is gone out of the ground sooner than the broad-clover. I never knew it cut more than once. Indeed cattle are never swollen by feeding on it, but then it affords but very little feeding for them, except the land whereon it grows be very rich. *Tull, p. 188.*

produce the greatest crops. I have known some kinds of pease that have produced about forty cods each plant, and each cod two or three pease apiece. So that to make an easy computation of the increase of one plant, it might produce in a year (or summer) about a hundred pease for seed. On the other hand, we have some sorts of pease that will produce about thirty cods upon a plant, and one with another, will yield seven or eight pease on each cod; and then a single plant will yield in one year, after the rate of seven in each shell, two hundred and ten pease; which is above double the number of those mentioned above, and the pease are also larger than those that bring so few. So that in the measure, there will be near two thirds difference, between the first and the last kinds. In beans likewise, it is observable, that some are apt to grow tall and long-jointed, while others are low and short-jointed, and bear full crops of fruit, even to yield half as much more in measure as those do which are long-jointed.

Thirdly, It is a custom among the farmers (though without any great reason) to sow some crops of beans and pease before *Christmas*, and others early in the spring, as in *February*, for example; the consequence is, that these two crops bring their fruit at one time, and therefore, about *London*, the markets are glutted with them, and their price is small. Besides, those that are put in before *Christmas*, are endangered by the frosts, and are often lost, which is a hazard that we need not venture, unless we have shelter for them and the help of a wall.

But let us suppose that we have three or four crops, which were planted at as many different seasons, that all are tending to bear fruit together, as I have observed them do oftentimes; we may prevent this inconvenience two ways: either by transplanting some of them, when they are about four inches high, or cutting them down, when they are about that height;
for

for then we shall find a considerable difference in the ripening of their crops. But if we let them grow till they are knotted for blossom, before we cut them down, then the young shoots which spring from the bottom, will, in a little more than a week, if the weather be hot, shoot out full of flower-buds, and come not above a week later than they would have done, if they had not been cut down. For the juices in the plant were then all so well digested and prepared for blossom, that wherever they could spring or appear, they must immediately tend to flower; whereas, when the juices in the main stem were raw and undigested, and the design of blossoming was not perfect in it, then the juices in the other part of the same plant, must be of the same kind; and a plant cut down in that state, will sling out off-sets, which, besides a time for their growth, must have due time to digest, and put themselves into a bearing-posture; which, from observation, I find to be a month or five weeks, if the weather be moderate; or somewhat less, if it is very warm (a).

I am yours, &c. R. B.

CHAP.

(a) Beans are of several sorts, but it is commonly the small horse-bean that is propagated by the plough. They delight chiefly in a stiff, strong moist clay, and thrive not in light or dry grounds. They are commonly sown in *February* or sooner. Three bushels will sow an acre.

The common white-pea succeeds best in a light land, somewhat rich: the time of sowing them is in the middle of *April*. Three bushels are the common allowance for an acre; and they kill the weeds a land is subject to, better than any other crop. In *Staffordshire* they sow the garden-rouncevals in fields, and they grow and yield very well, though they are left trailing upon the ground without any support of sticks. The white and rounceval-pea, are only to be sown with a broad cast, and harrowed in; but the common grey-pea, which is more frequently sown in fields than

CHAP. IX. Concerning the sowing of onions; and
planting, &c. of saffron, in a letter to Mr R. S.

SIR,

AS you desired my opinion concerning the planting of onions and saffron, and the soil wherein it is most proper to plant them, I assure you, that though I neglected to answer your letter, which bears date in *September*, till now, there is no time lost to you on that account, because it was impossible to do any thing to the purpose, in propagating either onions or saffron, so late in the year; for then onions are out of the ground, and saffron is in flower, as you observe in your letter; and it is next to killing them to move any lasting roots of that sort at that time.

In the next place, as you desired to know the native place of every tribe of fruit which we now cultivate in our gardens, it has employed much of my time to discover to what different parts of the world we owe those several enjoyments; each of which I shall mention in its turn; for I think it will be no small

than either of them, must be sown under furrow, and delights most in a cold wet clay. These are to be sown in *February*; and the common quantity of seed is two bushels to an acre. The blue-pea is the best kind for light sandy land, and is to be early sown; all pease love land manured with lime or with marle. In *Suffolk* they plough up their lays in the beginning of *March*, and turning the turf well, they have a cross-stick set with iron pegs, which they strike down with their feet: these pegs make holes at an even distance; into which they have boys and girls following to put the pease singly, till all the land is set. As soon as this crop is cut, they plough the land a-cross, and harrowing it well they plough it again, and sow it about *Michaelmas* with wheat, and the next year with barley, then with oats; after which the land requires new improvement. Mortimer.

small help to know the climate in which every sort of fruit had its original spring; for then we are able to give a better guess at the several situations and exposures necessary for each in our gardens: besides, by means of our extensive trade, we may learn even the qualities of those soils which nature has bestowed on every fruit-bearing plant, for its wholesome nourishment.

But, to begin with the onion: I am persuaded there is not any root which brings more profit to the planter, with small expence, than itself; for I find that an acre of onions, one year with another, may be made worth upwards of forty pounds; or even more profitable than if a quarter of that quantity of ground was spread or covered with one stratum or layer of apples, as close as they can lie together; for the hoe which goes between the onions is but two inches wide, or thereabouts, when they are bent in growth; and the onions in their roots, when they are full grown, one with another, may be about an inch and a half diameter, so that my conjecture is rather under than over the matter; for in orchard-trees, I am very apt to believe the apples produced by every tree, lying in a single layer upon a flat, will not cover that space of ground which the tree spreads over, besides the common hazard which the greater bodies are subject to, of being frequently blasted by their more aspiring growth, while the lower race lie under shelter, and safe from the bolder attempts of the air: so that for this reason an acre of onions is better than an acre of apple-trees, not only each single year, but one year with another. To this I may add, that many sorts of apples and onions, when they are sold in tolerable years by the peck, yield about sixpence *per* peck; these indeed are the refuse or scum of the crop, but in the same proportion, with regard to one another, do they bring benefit to the master, when they are the choicest of the crop; for the best of the onions are always cleaned and dried on kilns, and are much more refined in their flavour,

flavour, and more gentle and sweet to the taste than those which are not dried: by the first I mean those which are commonly sold about *London* in ropes, and by the other I mean those that are sold by the peck. The *Spanish*-onions are all dried, and therefore lose their peppered relish: besides, by the drying of onions, they lose that spirit of vegetation, which would else promote their growing before we could use them in the kitchen.

In the laying up of onions, we find that where they have not been well dried, or are laid too close together, or in too great heaps, they sooner begin to sprout than when the more watry parts are exhaled by the sun, and they are laid singly; so that it is necessary to guard against these two evils, if we desire our onions to last long in kitchen-use; but if we design to gather good seed from them, they should be planted, so soon as they begin to sprout.

Now, when we have taken care of the seed, we must sow it as soon as the earth begins to resume its power of acting upon vegetables of this kind. My greatest success was by putting in the onion-seed in *February*, as soon as the weather was open; and it has been my constant rule never to sow the seeds of any bulbous root later in the spring of the year: I find that if I sow any of this sort of seed later than *February*, my seeds are in danger of being lost, either by vermin in their tender state, or by a mixture of weather too rough for them, when they first appear above ground, or else by a too dry season, which is common in *March*, so that the seed does not come up at all.

The land that is commonly chosen for this purpose is a generous loam, which is supposed to consist of about equal parts of sand and clay; and even though this soil is more generally inclined to assist vegetables than any other, yet it is thought by some to require a large quantity of manure or dung, to make it agreeable

able to the vegetation of onions: but from my own observation I find that this loam of itself, without the charge of dung, brings onions as large and as good as the dunged ground: this I observed in some gardens where the people told me they never had applied any manure to the land, but what they had now and then taken out of the ditches, and the drift sand of the highways. In some other places I took notice of onions of a tolerable good size, and extremely well tasted, that were sown upon a black sort of sand, which soil seemed to be intermixed with about a third part of fibrous roots, such as the roots of heaths; and from the state of the land about it, I am persuaded it was so, and had not been long enclosed: but however, the people told me, when I spoke in praise of their onions, and inquired how they had enriched the land for them, that they had not done any thing more than to dig it up and sow the seed.

In my own garden I have had as good and large roots of this sort, without using any manure, as my next neighbour, who has covered his ground four inches thick with dung, so that I am of opinion, the great expence of dung may be saved in this case, and that sandy and heathy ground, and the loam which I have mentioned, may, by good digging or ploughing, and timely sowing, be rendered capable of producing a valuable crop. I have seen an acre or two of good onions growing in a sandy field, near *Windsor*, where little dung was used.

Again, in the management of a crop of onions, we must observe, that when they are grown to be as big as the stem of a crow-quil, they must be hoed, as well to clear them from weeds, which would annoy them while they were young, as to set the plants at a due distance one from another; the breadth of the hoe-blade, as I have observed, is about two inches, and it should be a careful man who is used to the work that is to be employed on that occasion, for
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there is not only required a great care in treading over the land, with regard to the young crop, but a foreseeing eye to guide and conduct the hoe forwards, that no more are cut up than what are necessary.

When the onions are thus put into a thriving method, we need not take any further care about them till we perceive their roots have nearly done growing, and then the common way is to bend down their leaves with an arbour-pole, or any other way more convenient; for the common people suppose that this way stops the motion of the sap, by which means the root benefits in its growth; and if that be the case, it is certainly worth while to do it; for if every onion in an hundred, one with another, should gain two ounces, and by this means every onion should gain but half a quarter of an ounce, then there would be a very considerable profit; and this additional weight will likewise prove additional in point of measure, so that an hundred roots which might perhaps fill the measure of a bushel without such an art used, then, if the art used had the effect it is supposed to have, we may expect half a peck added to every bushel, which at the least price of those onions, sold by the peck, is three-pence; and this in an acre well managed will about pay for hoeing. I confess I have followed the old beaten road so far as to do this, but I am not positive as to the success. All that I shall say therefore upon this point is, that as it is a received opinion among husbandmen and gardeners, I wish it has the effect, which it is commonly supposed to have; a small trial however cannot harm you very much.

When the pipes or leaves of the onions begin to lose their juvenile, or youthful green colour, and turn yellowish, it is time they should be taken out of the earth, and disposed in the best way to dry; therefore in rainy weather it is improper to pull them out of the ground; for which reason we should have some prospect

prospect of fair weather; such as we expect in the way of cutting grafs for hay, or reaping of corn; for onions must be well dried before they are laid up, or else they will not keep for household use (a).

And now, Sir, from these remarks we may gather enough to answer the end of your letter, as far as it relates to the method of improving land, by sowing onions upon it. I shall now proceed to give you some account of the manner how to propagate saffron.

Saffron has a bulbous root, like the spring-crocus, but much larger; the flower is also in most circumstances like the crocus-flower, and of a bluish purple-colour, but the times of blossoming of the crocus and the saffron are different; the crocus I speak of, appears in the spring, and the saffron-flower rises in autumn; the leaves of the one, and the other, are nearly of the same figure, but those of the saffron are much the longest, and are of a deeper green-colour than that of the spring-crocus. It has been observed by some authors, that the saffron differs from our spring-crocus, because

(a) The three sorts of onions propagated for the sake of their roots for winter-use, are the *Strasburg*-onion, the red *Spanish*-onion, and the white. These are to be propagated by sowing their seeds in the latter end of *February*, in a dry, and somewhat sandy soil, yet rich; in about a month's time the plants will appear, and, in about a fortnight after that, they will be forward enough for hoeing, which must be done with a very small hoe, cutting up all the weeds, and leaving the onions two inches asunder; this should be done in a dry season, and the ground will then be clear of weeds for a month. At the end of this time, they must be hoed again, and cut to three inches apart; and a month after this, to four inches, at which distance they will thrive well, and grow very large. Toward the latter end of *July*, the onions will have arrived at their full growth, which is known by their leaves hanging down, and shriveling; and they must at this time be pulled up, and spread on a dry place, and turned every day, to prevent their striking fresh roots; in a fortnight's time they will be dry enough to house, and should be wiped clean, and spread thin in an upper loft, or garret.

because it brings its flowers naked, or before any leaves appear, but so in effect does the spring-crocus; for when the flowers open, we can then narrowly distinguish the sharper points of the leaves, as we may do when the saffron comes to flower; the pistils of the saffron-flower, which are the parts only used in the shops, if they are not gathered early in the morning, while they are most prominent, will give us reason to complain: for when the sun begins to influence them, they shrink into less than half their first substance, and almost retire under ground; so the spring-crocus likewise does the same as soon as the flower begins to open by the sun's warmth.

But now let us proceed to the culture of saffron; and first of all remark upon the soil about *Saffron-Walden*, in *Essex*, which was once the chief market for it, as well as the principal place of its growth; but of late years we find it cultivated in the grounds about *Cambridge*, and in some other places in *England*, and find it prosper well in almost every kind of soil, except the stiffer sort of clay.

The soil then about *Saffron-Walden*, where I have seen it grow, is a chalky loam, but of that kind which is most easily broken; in some places there is a coat of light earth over the chalk, about three or four inches thick, which is sufficiently deep for saffron-roots; in other places I have seen some beds of it prospering well in common heath-ground, where the surface had been burnt, and turned in by a common plough. And I am satisfied from experience, that the saffron cultivated in this last sort of land, is not any way inferior, either in quantity or quality, to that which grows about *Walden* and *Cambridge*. Some gentlemen already, by my advice, have planted some acres of it upon heath-ground, and such land as was hardly worth one shilling *per* acre, and have had very profitable crops; for there is no dung, or any other manure wanted in this case, but what only is the

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produce

produce of the same ground, viz. the ashes of its surface.

When the ground has been well prepared with the plough, we are to provide an instrument like an hoe, but with a blade much broader than that of the largest common hoe. Some blades in the stiffer grounds may be about a foot wide, and for the more light and sandy lands, the blades may be about eighteen inches. With this tool or instrument the land is drawn into ranges, somewhat like furrows, about three inches deep. When one range is made, lay your saffron-roots in it about three inches asunder; when this range is planted, then, with the same instrument, draw another range on the side of it, and the earth which will be turned out of the second, will cover the roots planted in the first. In the planting this root it should be observed, that the depth of every range or furrow should, as near as possible, be the same: the time of planting these roots is commonly about *Midsummer*, for at that time the people in the saffron-countries generally take up their store out of the ground, and then they may be bought in the markets by the bushel, which is not always of one price. About that season we may meet with them, and at no other time. But however this custom prevails in the saffron-countries, I am sure from experience, that saffron-roots may as safely be taken up so soon as the leaves are dead, as to let them lie in the ground a fortnight or three weeks afterwards; for the deadness or falling of the leaves of any plant, shews its natural disposition to rest from growth, and then it has no great occasion for the earth's assistance, till the time draws near to its awaking again to its business of vegetation. But the ground being planted, some few flowers will perhaps appear in *September* following, naked or without any green leaves; and about the end of *September* or beginning of *October*, the green leaves will appear and shoot to a good length: then with an hoe, whose blade is
about

about three inches wide, cut the weeds which appear among the plants; but the leaves, which hold their greenness all the winter and part of the spring, should not be disturbed, because that weakens the root. Hares are great lovers of them, and therefore the country-people are obliged to fence in their saffron-grounds with hurdles, or some other good fence, to keep the hares out.

The next year after planting we may expect about a third or fourth part of what they esteem a full crop; and this year, as soon as the green leaves are decayed, clean the whole ground with an hoe, which will greatly help the roots.

The third and fourth years, with this ordering, we may expect full crops; but then the roots, and their offspring must be taken out of the ground to make fresh plantations; an acre of saffron-roots of this standing will plant about three acres and half.

When the saffron comes to flower, the blossoms must be gathered very early in the morning, because the style or pistil, which is the pure saffron, shrinks at the approach of the sun: therefore in great saffron-grounds, all the hands they can get are employed to pick it every morning while it lasts in flower. We must observe that it is only the style of the flower which is the saffron, the other parts are of no use; and I am very apt to believe there may be good saffron gathered from the blue spring-crocus, for there is little or no difference in the flowers of the one from the other sort; and if so, the spring will bear a tolerable crop the first year of planting.

As they gather the saffron, they put it between sheets of white paper, and dry it on little kilns, which every one is provided with; and the fire they use on this occasion is charcoal. The method of drying the saffron may be best seen at the flowering-season; for there is so much an art in the drying it, that barely

by that means, some saffron is rendered five or ten shillings *per* pound better than other saffron.

About three pounds of fresh saffron will dry to about one pound; and indeed I have known the year's crop gathered from one acre, to amount to near eighteen pound-weight; but ten pounds upon an acre is common enough. The price it will bear in the market, depends upon two things, besides the engrossing it; first, the plenty of it in the market, and secondly, the good management in drying it. As to the quantity of it, which is some years more, and some years less, that is occasioned by the greater or less number of full-cropt acres which happen to be on foot at one time more than another: for above four years it must not stand in any one place, but the ground broke up; and therefore it would be best ordered, to keep a parcel of lands so planted with saffron, that the full crops might gradually succeed one another. But if the blue spring-crocus answers the end I propose, the crop is much more certain, and its culture still more easy. In dear years, it has been sold for upwards of five pounds *per* pound; and in some years for a guinea; but however it be, the person who cultivates it is still a gainer by it (*b*).

CHAP.

(*b*) Saffron is always planted upon fallow ground, and that is preferred which has borne barley the year before. The saffron-grounds are seldom above three acres, or less than one; and in chusing, the principal thing regarded is, that they be well exposed; the soil not poor, nor a very stiff clay, but a temperate, dry mould, such as commonly lies upon chalk, and is of an hazel-colour. The ground about *Lady-day* must be carefully ploughed, the furrows being drawn much closer together and deeper, if the soil will allow it, than is done for any kind of corn; and accordingly the charge is greater. About five weeks after, during any time in the month of *May*, between twenty and thirty loads of dung is laid upon each acre, and having spread it with great care, it is ploughed in as before. About *Midsummer* it is ploughed
a third

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CHAP. X. *An account of bees; the manner how they gather their wax and honey; of the structure of their combs; their manner of breeding and swarming; with variety of curious observations relating to their oeconomy, by Mr Maraldi; as also some observations, which may be useful to such as either have, or design to build, bee-houses, or study the advantages of a well managed apiary.*

Naturalists allow, that bees are the most wonderful of all insects: the instinct they have to feed upon flowers, and to gather honey and wax from them; the order they observe in their different occupations;

a third time, and between every sixteen feet and a half, a broad furrow or trench is left, which serves as a boundary to the several parcels, when there are several proprietors to one inclosure. The fences consist of what is called dead-hedges, or hurdles. As to the weather, the hottest summers are certainly the best, and therewith if there be gentle showers from time to time. The next general part of the culture of saffron is the planting or setting the roots; the only instrument used for which is a narrow spade, commonly termed a spit-shovel. The time of planting is commonly in the month of *July*, a little sooner or later, according as the weather answers. The method is this, one man with his spit-shovel raises between three and four inches of earth, and throws it before him about six or more inches. Two persons, generally women, following with heads, place them in the farthest edge of the trench he makes, at three inches distance from each other, or thereabouts; as soon as the digger or spitter has gone once the breadth of the ridge, he begins again at the other side, and digging as before covers the roots last set, and makes the same room for the setters to place a new row at the same distance from the first, that they are from one another; thus they go on till a whole ridge, containing commonly one rod, is planted; and the only nicety

pations; their government, industry, and admirable skill in carrying on their work; in a word, all the dispositions that are to be found among these animals, have engaged the attention both of the antient and modern philosophers.

Aristomachus, amongst the antients, spent eight and thirty years in contemplation of them; and *Hiliscus* retired into the woods, that he might have the more opportunity to observe them: these two philosophers, according to the account given us by *Pliny*, wrote of the nature of bees; and they were the persons, perhaps, who taught others how to order them, to provide hives for them, and reap great advantages from them.

We are much beholden to *Aristotle* for the curious and useful observations he has left us concerning this insect, which *Virgil* has beautified, and put into *Latin* verse: these observations were afterwards confirmed and improved by *Pliny*, and several antient philosophers.

We have, notwithstanding the observations that have been made by so many learned persons, not declined

in digging, is to leave some part of the first stratum of earth untouched, to lie under the roots; and in setting, to place the roots directly upon their bottom. The quantity of roots planted in an acre is generally about sixteen quarters. From the time that the roots are planted, till about the beginning of *September*, or sometimes later, there is no more labour about them: but as they then begin to spire, and are ready to shew themselves above ground, it must be carefully pared with a sharp hoe, and the weeds, &c. raked into the furrows, otherwise they would hinder the growth of the plants. In some time after appear the saffron-flowers, these are gathered as well before as after they are full blown, and the most proper time for it is early in the morning. Having carried home the flowers, they are spread upon a table, and the chives picked out with a good part of the style itself, and the rest of the flower is thrown away as useless, and then they are dried on the kiln. *Philosophical Transf.* N^o 405.

elined to examine this part of nature, wherein we have been insensibly engaged; both by the pleasure we have had in so curious a study; and by the conveniency of a great number of glass-hives in M. *Cassini's* garden, adjoining to the Observatory. As several of the moderns, as well as the antients, have treated of the methods of managing these animals in point of profit, we shall wave that for the present, and content ourselves with inserting what we have found to be most curious concerning them.

Of bees, and their different species. The number of bees in a hive differs according to the different size of the hive; we reckon there are eight or ten thousand bees in a small one, and about eighteen thousand in a large one.

We have found three different sorts of bees in every hive, whether great or small: the first sort is that which we properly call bees, and which makes up in a manner the whole swarm: these are the animals, as we shall shew by and by, that gather the wax from the flowers; that work it, and make honey-combs and cells of it; it is they that gather the honey, and fill the combs therewith in summer-time, to maintain them in the winter; that take care to supply their young with food suitable to their age, and excite a heat, which contributes to bring them to their full growth; lastly, these are the creatures, whose business it is to keep the hive clean, and to drive away whatever may be injurious to them. All these bees have a sting; and of this species, there are some that are a little bigger than others.

The second sort is what is called drones; these being bigger, and their colour being a little darker, will help you easily to distinguish them from others; for the drones are one third longer, and a little thicker than the bees. Some hives have but a small number of drones, others have many; and there are some seasons of the year, when we could discern none of them;

we have likewise sometimes found drones no bigger than the common bees; no drone has a sting.

Finally, we have observed a third sort of bees in the same hive, that are even longer than the drones, but not so thick in proportion to their length, and they have a more lively and redder colour; we never found above three of these in a hive, and often but one: this bee has a grave and composed gait, and is armed with a sting; she is the mother of all the rest, as we shall shew hereafter, but is generally stiled the queen, or king-bee.

Description of a bee. You may distinguish three principal parts in a bee; the head, which by a small fibre adheres to the rest of the body; the middle of the body, which is the second part; and that is also distinguished from the belly, which is the third part.

Bees have two kinds of saws or jaws in the lower part of the head, which open and shut from the right to the left; it is with this organ they gather the wax, knead it, and build and polish their cells; they also use it to carry whatever they have into, and out of, their hives.

At the same end of the head, bees have a trump, whose origin is near the neck; it grows smaller and smaller from the root, and ends in a point. This organ consists of five branches, whereof two are separated from the rest at their roots, on the right and left; the other three are not divided from one another till towards the middle of the trump; the middlemost is of a cylindrical form, and as thick as a hair, and being viewed with a microscope, seems all along to be divided into several rings, each of which is furnished with a great number of small hairs, which are longer towards the end of the trump, than at the root. This part, which we properly call the trump, is one of the chiefest organs bees are endowed with; for with that they gather honey and food from flowers, as we shall observe by and by.

The

The other four organs are longer towards their origin, and grow smaller and smaller till they end in a point: they are formed like gutters, being concave on that side which embraces the trunk, and convex on the other; they are of a horny substance: the two branches, which are separated nearer the root, are longer, and embrace the other two; they join so well together, that they seem to be but one pipe.

We are certain from repeated observations, that the bees gather their honey with their trump alone, and this organ appears to us to be a chanel into which the honey may pass. We have likewise seen the trump of the bees grow bigger or lesser by turns, it is bigger at the very instant the bee sucks the honey; and as this increase or diminution happens successively from its point to the very root, this made us conclude, that the mellific juice causes that swelling, as it passes into the cavity of the pipe: but it may also be supposed, that the trump from the middle is as it were the tongue, and that the branches which encompass it assist in the office of gathering honey: the tongue, after having gathered the honey from the flowers, sends it through the branches as far as their roots, where it enters into the body of the bee, through which they are wont also to discharge it. These are the chief parts of the head, and their several uses, so far as the smallness of them will allow us to come at the knowledge of them.

The middle part of a bee's body is of a spheroidical form, a little extended, to which two wings are fastened, one on the right and the other on the left, a little above the horizontal line, which passes through the middle of the body; each of these wings has another, which seems to adhere to it, and is a little smaller than the first, which lies next the head: it is with these four wings they make their humming noise, as a signal to each other.

It

It is also on this part of the body, towards the lower end, that they have six legs, *viz.* three on each side: two of these legs are near the head, and are the smallest of the six; the other four are fastened behind to the side of the belly, and very near one another; the two middlemost are somewhat longer than the first, and shorter than the hindmost: all these legs have several joints, of which there are three that are bigger than the rest. Besides these three joints which are towards the middle of the leg, there are others towards its root, and the end of each leg; the joint in the middle of both the hind legs is much larger than the others, and we may observe on the outer side a small cavity, like the hollow of a spoon, surrounded with a great many small hairs; it is in this cavity that the bees deposit by degrees the particles of wax which they gather from the flowers of plants as aforesaid: but we must take notice, that the legs or thighs of the drones, and of the queen of the bees, who gather no wax, have not this cavity.

The ends of the legs terminate with two sorts of hooks back to back, with which the bees fasten themselves together on the sides of the hive, and form divers figures, as one time a cone, another time a plane, and sometimes a festoon; from the midst of these two hooks a small and slender appendix arises, which is sometimes folded and sometimes extended; it is very slender and roundish: bees make use of this part to fasten themselves to, and to walk upon polished things as upon glass: I am also of opinion, that they make use of this part to gather the small parts of wax from the flowers, and convey them from hand to hand to the hind legs.

The last part of a bee is the belly, which is distinguished into six rings: we have observed two parts in the inner side, one of which is a bladder, wherein the bees deposit the honey which they suck from the
cup

cup or calyx of the flowers, after it has passed through the trump, and a very narrow chapel that traverses the head and breast of the bee: this little bladder, when it is full, is about the bigness of a small pea; and is so transparent that you may see the colour of the honey through it (a).

Another remarkable part is the sting, which lies at the extremity of the bee's belly, and shoots in and out very readily, by the means of some muscles placed very near it; the sting is about the sixth part of an inch in length, and is somewhat thicker towards the root than towards the head, which terminates in a sharp point: it is of a horny consistence, hollow within like a pipe, through which a venomous liquor passes, which being contained in a bladder within the belly, and a little distant from the root of the sting, comes out near its point, and insinuates itself into the wound at the same time that the sting penetrates the flesh.

The bee commonly leaves the sting in the wound, and the sting drags the bladder along with it, and sometimes part of the insect's guts: if the sting be presently taken out of the wound, it will swell but a little, because it does not give the poison proceeding from the bladder time to insinuate itself into the wound: but if we are not nimble in taking it out, all the venom will soon get into the blood, and cause a great swelling and pain, that sometimes lasts for several days. But here I shall take the liberty to insert

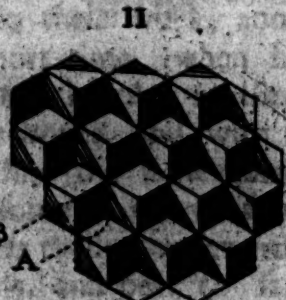
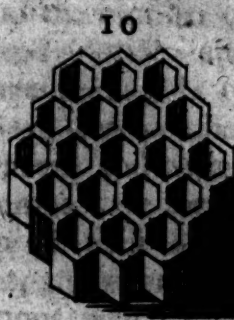
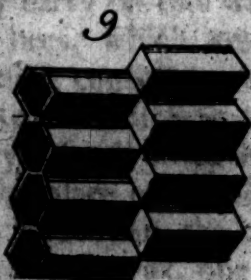
(a) The parts chiefly used in their labour are, two scrapers wherewith they gather wax; two arms wherewith they work in making combs; and another part, called by *Leuwenhoeck* a wiper, wherewith he supposed them to wipe the honey from off the flowers. But this last part *Dr Garden* chooses to denominate the sucker, or proboscis, as being hollow, and composed of circular fibres, and serving to imbibe or suck up the honey from plants.

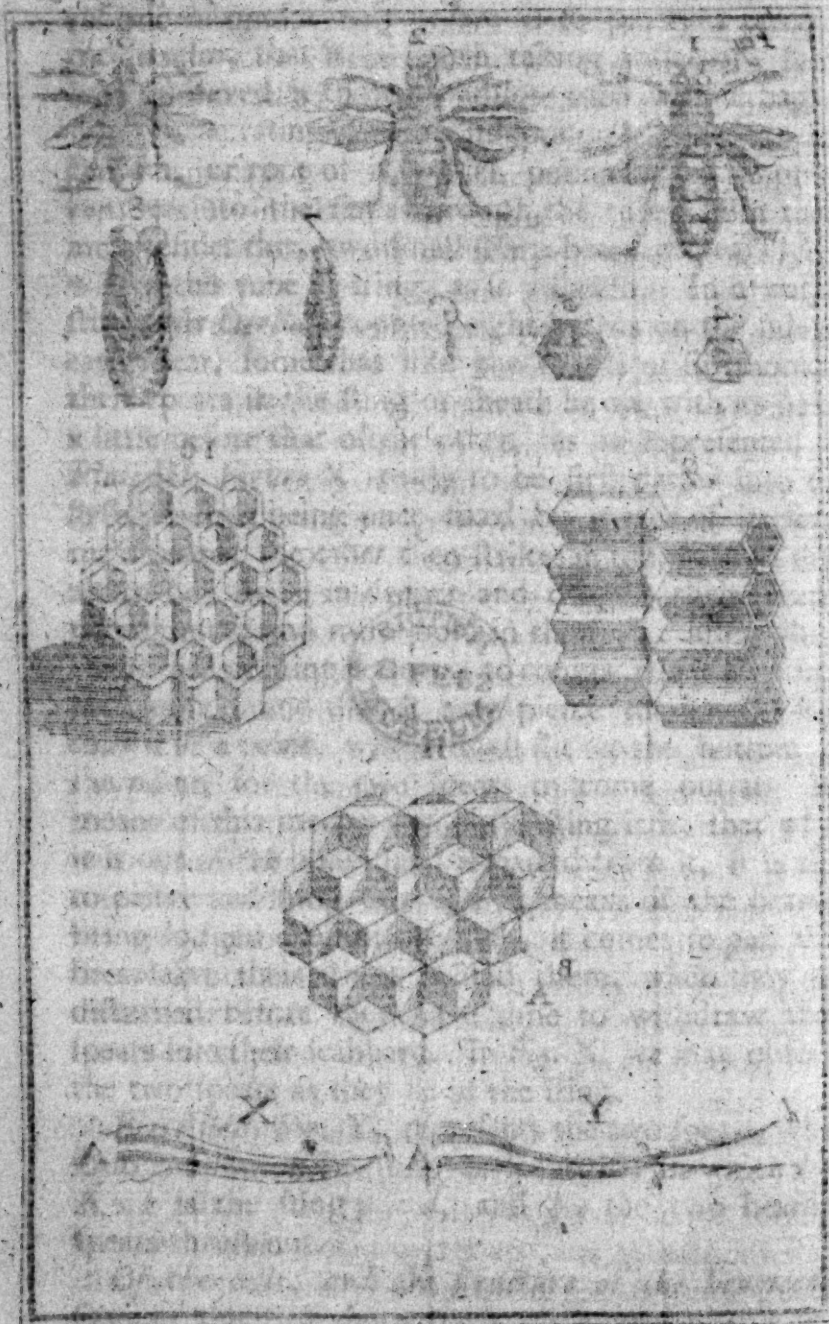
sert the excellent Mr *Derham's* observations upon the sting of a bee, for the satisfaction of my reader.

The sting of a wasp or bee is so pretty a piece of mechanism, that it is worth taking notice of; some have observed it to be an hollow tube with a bag of sharp penetrating juices (its poison) joined to the bottom, or root of it, which poison is, in stinging, injected into the flesh through the tube. But there are, besides this, two small sharp-bearded spears lying within this tube or sting, as in a sheath. In a wasp's sting, Mr *Derham* counted eight beards on the side of each spear, somewhat like the beards of fish-hooks: these spears in the sting or sheath lie one with its point a little before that of the other, as is represented in *Plate III. Figure X.* ready to be first darted into the flesh; which being once fixed by means of its foremost beard, the other then strikes in too, and so they alternately strike in deeper and deeper, their beards taking more and more hold in the flesh: after which the sheath or sting follows, to convey the poison into the wound; and that it may pierce the better, it is drawn to a point, with a small slit at the bottom of the point, for the two spears to come out at. By means of this mechanism of the sting it is, that when it is out of the body, and is parted from it, it is able to pierce and sting us; and by means of the beard's being lodged deep in the flesh, it comes to pass that bees leave their stings behind them, when they are disturbed before they have time to withdraw their spears into their scabbard. In *Fig. X.* we may observe the two spears as they lie in the sting.

Plate ibid. Fig. Y, represents the two spears, when squeezed out of the sting or scabbard, in which *Fig. A c b* is the sting; *c d*, and *b e* the two bearded spears thrust out.

Of the cells, and the structure of the honeycomb.
One of the first things bees go upon, after a new swarm





swarm is put into a hive, is to form their cells; they apply themselves with so much diligence to this work, that we have seen them make a honeycomb in one day of a foot long and six inches broad; and which, according to the usual bigness of the cells, might contain near four thousand bees.

They begin their work by fastening it to that which is most solid in the upper part of the hive, and they continue it from the top to the bottom, and from one side to the other; and that they may fix it with the more solidity, they sometimes make use of wax so tempered that it is almost like glue.

It is not easy to account for the manner wherein they carry on this work, by reason of the number of the bees, which are at once in grand motion, and seeming confusion; however, we have been able to make the following remarks. We have seen each bee carry a small bit of wax between his chaps, and hasten to the place of business, where the combs were forming, and where the bees, by the help of their jaws, fastened the wax, one time on the right, and at another time on the left, to their work, about which each bee spent but a short time, when he went away; but there is so great a number of them that succeed one another in their works, and with so much celerity, that you will find the honeycomb increase sensibly enough. As some of the bees work upon the cells, there are others that go backwards and forwards in the framing cells, and beat the same with their hind parts, seemingly in order to make it solid and more firm.

The order they observe in building the cells is this: they begin with forming the basis, which consists of three rhombuses or lozenges; they presently make one of these rhombuses, and trace two planes on each side of this rhombus; they add a second rhombus to the first, with something of a declivity, as we shall observe hereafter, and trace two new planes on each side of this

this rhombus: finally, they add a third to the two former; and raise two other planes on both the outside of this rhombus, which with the other four form the cell; and by this disposition of the basis the cell necessarily becomes an hexagon.

While some of the bees are employed in building the cells, others apply themselves to finish those that are newly traced, which they do with their jaws, with which they smooth the angles diligently, and finish the sides and basis with so much delicacy, that three or four of these sides being laid upon one another, are no thicker than an ordinary sheet of paper; and forasmuch as the holes through which the bees go in and out of the cells, for which there is but just room for them, would be too brittle, and easy to be broken, by reason of that thinness, they strengthen each of them with a welt of wax.

We have observed, that those bees which build the cells, generally work but a short time together upon them; but it is not so with those that polish them, for they continue long at it, and yet use much expedition, without ceasing from their labour any longer than while they carry out of the cells those little bits of wax which they have taken off in polishing; and to the end that this stuff may not be lost, there are other bees ready to receive it of those that polish the work, or come to take it out of the cell, out of which those who are employed in polishing readily withdraw, and go to work in another place.

There are other bees appointed to assist those that are employed in polishing; for we find them often giving them either honey or some other liquor needful, either for their work or their own sustenance.

Each honeycomb has two rows of cells opposite to one another, with their bases in common, and each honeycomb is somewhat less than an inch thick; thus the depth of each cell will be somewhat more than the third part of an inch: we have found in several honeycombs

neycombs of a foot long, from sixty to sixty-six rows of cells; each of them therefore must be a little more than the sixth part of an inch wide, which is about a third of its whole length.

The honeycombs are almost all built of this bigness, except a small number of others in some parts of the hive, which are larger; these cells are somewhat more than the fourth part of an inch wide, and about half an inch long; and are made to deposit the worms in, which change to drones, as we shall shew hereafter.

Moreover, we find in several parts of the hive three or four cells bigger than the former, and made differently from them; they are of a spheroidical form, open in the nether part, and fastened to the ends of the honeycombs: we do not certainly know the use of them, but they are supposed to be the arbours or habitations of their queens.

The bases of all the honeycombs are placed at such a distance from one another, that when the cells are finished, there remains no more space between the one and the other, than is sufficient for two bees to go a-breast: these honeycombs are not continued from the top to the bottom, but are often interrupted; and besides this, they have openings at certain distances, that there may be an easier and shorter communication between them.

After having explained the manner of building the cells, we come more particularly to consider the structure of them.

Every basis of a cell is formed by three rhombuses, that are almost equal and alike, which, pursuant to the measures already observed, have two obtuse angles, each of one hundred and ten degrees, and consequently two sharp ones of seventy degrees each.

These three rhombuses lean one towards another, and are joined together by the sides which contain one of the obtuse angles; and by their inclination form a mutual

mutual solid angle, which, by reason the rhombuses are commonly equal, meet in the axis, and are answerable to the middle of the cell; the other six sides of the same rhombuses, besides the three obtuse angles, form also three other angles by a mutual inclination, where they join together by the two sharp angles.

These same six sides of the three rhombuses are so many bases, on which the bees raise their planes, which form the six sides of each cell; each of these sides is a trapezium, which has a sharp angle of seventy degrees, another obtuse one of one hundred and ten degrees, and the two angles of the trapezium, which are on the side of the opening or entrance, are right angles: we are to remark here, that the sharp angle of the trapezium is equal to the sharp angle of the basis; and the obtuse angle of the same rhombus, equal to the obtuse angle of the trapezium; the six trapezia which form the six sides of the cell, touch one another two and two by the equal sides, and are in such a manner joined to the rhombuses, that the obtuse angles of the rhombuses are contiguous to the obtuse angles of the trapezia, and the sharp angles of the trapezia to the like angles of the rhombuses.

Now, in order to know the connexion between them, and how the two opposite rows of cells are formed, you must suppose several other bases like the foregoing, that is, that they have three rhombuses with the same angles, and that these rhombuses lean one towards another, as in the first basis. You must then suppose, that these bases are applied one to another in such a manner that the analogous angles of the one are answerable to the angles of the other. These bases perfectly join together; or three rhombuses of three different bases, by the junction of two of these bases with a third, form the basis of a new cell like the former, with this difference, that the concavity of the solid angle is turned towards the other face of the honeycomb, where another row of cells is formed

formed opposite to the former; and by the junction of six bases with a seventh, three new bases are formed, which have the concavity of a solid angle, turned also contrary to that of the seven bases: in like manner, by the application of twelve new bases to the other eight, other nine bases are formed, with the concavity of the angle turned opposite to the twelve; it is by this admirable contrivance that the two rows of cells are formed in the two faces of the honey-comb.

There are by this method of building three rows of rhombuses in three different planes, so well contrived, that several thousand rhombuses of the same order are found to be all exact in the same plane: thus indeed it is astonishing, that several thousands of animals should, by instinct of nature only, concur to make so difficult a work with so much order and regularity.

We are, in the next place, to consider the consequence of such a fabric. It has been observed already, that each basis has three rhombuses, and that there is a plane on each side of these three rhombuses, which serves for a side to an opposite cell: but, besides this use of the three planes, they also serve for a prop and support to the basis of the opposite cell, and supply what might be deficient by reason of the great delicacy of the work. Secondly, the concavity of the solid angle, which is in the middle of the basis, serves by an admirable provision of nature, to keep close together the particles of honey in a small space, which the bees daily supply the small worm with for his food, and with which he is daily encompassed after he is deposited there, as we shall shew in another place; the honey, which is liquid when it is gathered, might, without such a disposition of the basis, run off, and so abandoning the embryo, destroy it.

Besides these advantages which arise from the form of the side of the basis, there are also others which

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depend

depend upon the number of the angles of the rhombuses: it is upon their bigness that the magnitude of the angles of the trapezia has its dependence, which form the six sides of the cell; but finding that the sharp angles are seventy degrees thirty-two minutes, and the obtuse ones a hundred and nine, and twenty-eight minutes; those of the trapezia, which are contiguous to them, ought also to be of the same bigness: moreover, the solid angle of the basis is by this bigness of the angle of the rhombuses equal to each of the three solid angles formed by the obtuse angle of the rhombus, with the two obtuse ones of the trapezia; from this bigness of the angles there results not only a greater facility and simplicity in the structure, but a more beautiful symmetry from the disposition and form of the cell.

Finally, the bees make their cells a regular hexagon, by a kind of skill in geometry, as *Pappus* a famous geometrician of the second century has observed: there is that property in this figure, that if you place several of them near one another, they fill up a space round the same point, without leaving any vacuity between one figure and another. There are two other figures that have the same advantage, and those are the equilateral triangle and the square; however, they have not the same capaciousness as the hexagon.

It is therefore with wisdom, that the bees, according to the opinion of the said mathematician, prefer the hexagon before other figures, as it contains a greater quantity of honey in it than the triangle or square would do.

Of the generation of bees. The bee which they call the king or queen, is the parent of all the rest; she is so fruitful, that as far as we are able to judge, she produces eight or ten thousand young ones in one year, for she is usually alone in the hive one part of the year; and the hive towards the end of the summer

mer is as full of bees as in the beginning of the spring: in the mean time one swarm goes out every year, and sometimes two or three, each of them consisting of ten or twelve thousand bees.

The queen generally remains concealed in the inner part of the hive, and is not to be seen but when she deposits her young in these combs which are exposed to view.

It is upon these singular occasions, that we have been able to discern her, though in that case she is not always to be seen; for often then we find a great number of bees fastned to one another, and forming a kind of a veil from the top to the bottom of the hive; so that they interrupt our sight, and do not remove thence till the queen has laid her young.

When she appears in public, she is always attended with ten or a dozen bees of a larger size than ordinary, who are as it were her retinue, and follow her wherever she goes, with a composed and very grave gait. Before she lays her young, she puts her head for a moment into the cell, where she designs to deposit them; if the cell be found empty, and has in it neither honey, wax, nor any embryo, the bee immediately turns about, and thrusts the hinder part of its body so far as to touch even the bottom of the cell: the bees which attend her, at the same time, stand round about her, with their heads turned towards her, and caress her with their trumps and legs: this lasts but for a very little while; after which she comes out of the cell: and then we may perceive a small white and very slender egg, about the four and twentieth part of an inch, or a little more, in length, and four or five times as long as it is thick, a little more sharp-pointed at one end than at the other, with the thickest end set upon the basis in the solid angle of the cell. This egg is formed by a thin, white and smooth membrane, which is full of a whitish liquor.

The great bee instantly after she has laid an egg in one cell, passes with all the same circumstances, and with the same number of attendants, to lay another in a neighbouring cell; and we have observed her, in this manner, lay eight or ten in different cells, immediately after one another: she retires after she has done laying, accompanied with the same bees into the inner part of the hive, and we see no more of her.

The egg, which lies in the bottom of the cell, continues for four days in the same condition, without any alteration as to form or situation: but upon the expiration of that time, we find it changed into a maggot, whose body is jointed in several rings, and is folded up in such a manner, that the two ends touch one another. It is then encompassed with a little liquor, which the bees, at the four days end, place at the solid angle of the basis. What the nature of this liquor is cannot be known, by reason of the smallness of its quantity; and so we remain in doubt whether the same be honey, carried thither by the bees, for the nutriment of the embryo, or some other matter proper to fructify the sperm; for it appears to us to be more whitish, and not so liquid and transparent as honey.

But of what nature soever this first liquor may be, wherewith the small worm is encompassed, it is certain that the bees afterwards carry honey for its nourishment, and bring the worms a greater quantity of food in proportion to their growth, till the eighth day, when they augment it so much, that it takes up the whole breadth of the cell, and a great part of its length: after which the bees take no further care of these young ones, but stop up all the cells which contain them. After the stopping of the cells, the worms remain twelve days longer, during which time the embryo's undergo divers changes, which we have discovered,

discovered, by opening those cells on different days from the time they were stopt up. First, the worms change their situation, and instead of the foldings that were before on the basis of the cell, they extend themselves in length, and place their heads towards the mouth of the cell; the worm's head is a little unfolded, and we may then begin to see some small lengthenings, which, in my opinion, are the first beginnings of the trump; a black point may also be seen upon the front of the head, and at a little distance from it a black streak upon the back, which does not reach to the extremity of the worm: you may in like manner, discern the first lineaments of the legs, but these are very minute.

When the head is formed, and the trump extended, all the other parts begin afterwards to appear; inso-much that the worm becomes winged, and grows by degrees a perfect bee, except only that she is white and soft, and has not that kind of crufted skin with which she is afterwards covered.

The worm, by this transformation, divests herself of a white and very fine skin, which sticks so exactly to the inner sides of the cell, that it assumes the same figure of angles, as well at the basis as on the sides, and seems to be but the same body.

The bee being divested of this pellicle, shews six legs ranged upon her body, in the manner we have already observed. The trump, with its quaternal covering, is situated in its full length in the midst of the six legs, from the head almost to the extreame part of the body: the wings lie along the two hind legs on the side of the belly; they are not then at their full extent, but lie in several folds.

The bee being in this condition, there are several parts of her body that change colour one after another. The eyes at first are of a dark yellow, but they afterwards become of a violet-colour, and at last black.

black. The three-points which form a triangle with equal sides on the top of the head, are afterwards found to be of the same dark yellow, and then changing as the eyes do, at last become black. The ends of the wings are tinged with a dark colour. The horns are equally divided into two parts by joints, and undergo a change; first that which is farthest from the head, and then the nighest to it. The trump and the legs appear at the same time of a chesnut-colour. The whole head, as well as the breast, forms a bright earth-colour, and becomes gradually darker. The wings expand themselves, and extend to their natural length. We also begin to observe the hair which covers the bees, and is formed and disposed upon the head, breast, and the rest of the body, in a very agreeable manner.

The bee, after having undergone all these changes, becomes a perfect insect, and from the twentieth day of her age, endeavours to get out of her cell; she makes then a round hole with her jaws in the cover that stopt it. When the bee is advanced so far as to quit the cell, she seems drowsy, but quickly assumes her natural vivacity; for she may that same day be seen coming out of the hive, and returning from the fields laden with wax like the rest: you may distinguish these young ones by their colour, which is a little darker than the old ones; and by their hairs, which are more whitish.

After the young bee has made her passage out of the cell, two other bees go thither presently; one of which takes away the cover, and uses the wax which it was made of elsewhere; the other is employed in refitting the opening: for the young one having left it round or unequal, when she made her way out, this same bee puts it into its first hexagonal form, strengthens it with the usual border, and clears it of the little pellicles left by the young bee, which perhaps are the off-castings of the shanks; for as to that

new

new pellicle which incloses her whole body before she leaves the cell, we are of opinion, that it sticks, like the other before mentioned, to the inner sides of the cell: these pellicles so sticking to the cells, make them change colour; and hence it is that we find honeycombs in one and the same hive of different colours: those wherein there has been nothing but honey being of a bright yellow, and those out of which the young bees come of a dark yellow; we have sometimes pulled off from a cell, which has been the cradle of several bees, no less than eight of these pellicles one within another. When the cell is brought to its former state, the bees sometimes the same day lay new eggs therein; they now and then put in honey first. We have seen bees lay their young in the same cells at five different times within the compass of three months.

The manner wherein bees gather wax. Bees gather two sorts of wax that are different from one another; the first, which is brown and glewy, serves to stop up all the holes in the hive, and sometimes to stick the honeycombs to the hive; the other sort is the ordinary wax they make use of in building their cells.

They gather the common wax from the leaves of a great many trees and plants, and from all flowers that have chives or apices; they gather a great quantity from the flowers of rocket, and especially from those of the common poppy, which have plenty of these chives; they often have their full load before they get out of one of these flowers; but they are so prodigiously nimble at their work, that how attentive soever you may be in observing them, it is with much difficulty your eyes can follow them, nor are you able to find out the way they take the dust from the flowers: it is indeed certain, that they sometimes gather the wax with the hairs which cover their bodies, which they roll upon the flowers; for they may be seen returning out of the fields with their hairs full of small particles of wax like dust, but this comes to

pass only when the mornings are moist; the humidity which is then upon the flowers, being perhaps the cause why these particles cannot so easily be put together in that part of their bodies where they are wont to deposit them; but when they are got into the hive, the warmth therein causing the moisture to evaporate, they can the more easily gather the wax with their feet, by stroking their hairs several times with them.

They often gather the wax with their chaps and two fore legs; from these they convey them to the middlemost, and thence afterwards to the joint in the middle of the two hinder legs, where at last it is found gathered together, to about the bigness, and in the shape, of small lentils. This joint is larger than the others, and has a small cavity like that of a spoon: again, this concavity is encompassed with small hairs, which serve to keep the wax in its place, to the end it may not fall off when the bees return to the hive.

Besides the use of these parts which nature has furnished bees with, they likewise use a wise precaution, that they may not lose the fruit of their labour: as the bees convey the particles of wax to the hind legs, they squeeze them together; and this they do by the help of the two middle legs, which they turn backwards, and apply them several times, and in different ways, upon the wax, in the same manner as we are wont with both hands to squeeze such particles as we have a mind to press together. These are chiefly their occupations and cares, till being laden with a sufficient quantity of wax, they are ready to take the wing, and return to the hive; and if the flowers upon which they alight are agitated by the wind, they seek out a more quiet place, and such as is more proper to shelter them from the stormy motion of the air.

When

When the bees are got into the hive, they disburden themselves of the common wax two different ways; for resting upon their two fore legs, they make several motions with their wings and bodies, sometimes to the right, and at other times to the left; and, as if this motion and noise were made on purpose to give notice to their companions, three or four of them come and take each a small quantity of the wax with their jaws; after which come several others, who take their share of the lading till no more remains, and then they return into the fields for a new harvest.

This is also the way they disburden themselves of the other sort of wax, or rather glue, which sticks so fast to the bee's thighs, that both those that come to take it off, and the others that are laden with it, are obliged to use their utmost efforts on both sides to get it off.

But when the hive has a great many cells, they use a more ready and expeditious way, and such as stands in need of no help, to get rid of the common wax. The laden bee finds out a cell where is neither honey nor any worm, and then with her two fore feet fastening herself to the upper edge of the cell, she afterwards folds her body a little forward, in order to put her two hind legs into the cell. In this posture she turns the two middle legs backwards, and so slipping them from the top to the bottom along the two hind legs, where the two lentils, like bodies of the wax, are lodged, she loosens them by this means, and leaves them in the cell.

There are some that content themselves with letting the wax thus drop into the cell, without taking the pains to put it in order; but most of them go into the cell, and very dexterously dispose the two little bodies of wax above mentioned, so that they may lie by the side of one another in the bottom of the cell, and then withdraw.

Another

Another bee presently succeeds the former, out of those that attend, from the arrival of the laden bee at the cell, where it discharges the wax, and these attendants by turns carry on the work: if the two bits of wax are not placed as aforesaid, they carry them into the bottom of the hive, and temper them with their two jaws for half a quarter of an hour; inso-much, that when the bee withdraws, those two small bodies of wax are reduced into the consistence of a paste; which gives us cause to think that the bees, in tempering the wax, mix some liquor therewith, either honey or some simple moisture proceeding from the place from which they are wont to discharge the honey, and with which the bladder was perhaps filled.

Several other bees come in the same manner to unload in the same cell; and as one goes, another comes on, to temper the wax, till the hive is almost full of this sort of wax, placed sometimes in lays of divers colours, as white, yellow, red, and brown, according to the flowers or leaves from which the wax has been gathered by different bees.

We find in several parts of the hive a great number of cells full of this wax, and they are, as it were, the magazines to which they have recourse upon occasion; for as it is their business for a great part of the year on certain days to cover the cells, wherein their young are enclosed, and to stop up those that are full of honey, it is necessary they should have a store by them for that purpose.

The wax which is found in the cells is not yet so perfect as that of which the honeycombs are formed; for though the first be tempered with some moisture, yet, if you press it between your fingers, you may reduce it to dust, whereas the other wax is a kind of thickened paste: the bees therefore, before they use it in the building of their honeycombs, must fit it for that

that purpose; and that which likewise induces us to believe this, is, that the wax in the cells, which is at first of different colours, is always white immediately after the honeycombs are built.

Of the gathering of honey. Bees gather honey from those flowers whose calices are no deeper than the length of their trumps: but each flower contains so little honey, that they touch upon a great many before they get together a sufficient quantity to fill the small bladder that is the receptacle for it, as we remarked in the beginning of this discourse. As soon as the bees alight upon a flower, they extend their trump, and convey it to the bottom of the cup or calyx, where they suck the honey; but when they find the bladder is full, they return to the hive, and carry the honey into a cell, where they discharge it by that part of the head situated between the two jaws, which they extend more than usual, and keep but a little open: they deposit the honey by moving their heads sometimes on one side, and sometimes on the other; and when they find a drop happens to be ill placed, they extend the trump to take it up, and then order it in the same manner as the rest, by discharging it as before from that part of the head that is between the jaws. As the honey which one bee carries at a time, is but a small portion of that which the cell can contain, the honey gathered by a great many bees must go to fill it (*b*).

When the cells are full of honey, they stop up those they reserve for their winter-store, with a very thin wax-cover; but those cells which contain honey for their daily food, are open, and at the disposal of the whole swarm. That honey which is to be used last

(*b*) For the manner wherein the honey and waxy humors are secreted from the juices of the plant, authors are divided. Some suppose it done by coagulating the vegetable juices; others by only separating the caseous parts thereof already coagulated.

for their sustenance is always put into the most inaccessible place, that is, in the upper part of the hive, if it has no lid that can be taken up; but if it has one, they leave the empty honeycombs in the upper part, and deposit the honey in the middle of the hive.

Of several other particulars concerning bees. Besides what we have already observed concerning bees, nature has endowed them with other talents, which we judge to be worthy of observation. They love property, and there is nothing they will not undertake to preserve it. They use the glue which they gather, to masticate the glasses round the hive, and even the hive itself round the foot-stall, so that they can by this means hinder the least insect from getting in.

There are bees that watch the mouth or entrance of the hive, to oppose those insects that would get in that way; and when one bee is not strong enough, several others come in to her assistance.

It would be too tedious to recount all the remarkable things we have observed upon this occasion; let it suffice that a snail, which forced her way into the hive, notwithstanding the efforts of several bees, after they had killed her with their stings, was found covered all over with this mastic or glue, as if they designed thereby either to hinder the stink her flesh might make in the hive, or to hinder the production of worms from the putrefaction.

Nature has furnished bees with a most exquisite smell, for they will scent the honey and wax at a great distance.

They have divers ways that would incline a man to believe that they have understanding; they are apt to fight and kill one another, not only in a single combat, but in a body; which yet does not usually happen, unless it be in autumn, when the stock of honey is not enough to support the whole swarm during the winter.

They

They seem to have some knowledge of good and bad weather: for they not only keep within, when there is any likelihood of bad weather, but if any storm happens when they are abroad, they avoid it, by quitting their work, and returning to the hive almost all together, and with much precipitation; they do the same when they are surprized in the fields by some rain, though never so little.

Nothing agrees better than heat with bees, the more intense it is, the more they are animated to, and the more active at, their work; cold, on the contrary, is very injurious to them: and let them be never so vigorous when they are in the hive, if they go out of it in winter-time, they are so seized therewith, that they appear to be almost immediately motionless; but if you bring them near a fire, the heat it yields will restore them to their former vigour.

To fortify themselves against cold in the winter-season, they place themselves in the middle of the hive, as near one another as they can, in that space which lies between two honeycombs; there they agitate their bodies from time to time without changing place, and this motion excites a heat, which secures them from external cold, and is often so considerable, that it is communicated to the glasses of the hive. It is likely, that they succeed one another in this work, for there is a continued motion, night and day, in the hive; and there are some of them which take their rest in the day-time: and this rest even conduces to the benefit of the public, for their presence in the hive helps the heat, by the means of which the young ones inclosed in the cells are hatched; which we have found true by the following experiment.

We have sometimes taken off a piece of a honeycomb, in whose cells there were young worms, and left it in the bottom of the hive, and found a great number of bees sitting upon these combs, where they continued till the young ones came out perfect bees,
after

after which they wholly forsook the combs; this also shews the care which the common bees take of the young.

We have taken notice of the several ways and motions by which they understand one another: for example, when a bee is at work upon the combs, and requires honey of another which brings it from abroad, she that wants the honey extends her trump, and takes it from between the other's jaws; and as the one discharges the honey through that part, the other receives it with her trump, without spilling a drop; they likewise understand one another, when by the motion of their wings they require to be disburdened of the wax which they have gathered in the fields, and also in the morning they excite one another to go out to work. Lastly, when several bees have a mind to quit a place, if one makes a motion with her wings that causes a small sound, all the rest, according to her example, make the same motion, and retire: I believe this is the way they give notice to one another in the hive, when they make ready to go forth and swarm.

Of the drones. The drones are usually one third thicker and longer than the bees; they have a rounder head, and are more thickly covered with hair: it is certain they have no sting, and that their inward parts differ from those of common bees.

They are seldom seen out of the hives, and when they do go forth, it is about two or three in the afternoon, and never but in fair weather. They do not return laden with wax, but we have found their bladder full of honey, like the other bees, which they have either gathered in the fields, or taken from the hive before they set out, which last is most likely; for we could never see them alight upon the flowers: neither after their return to the hive could we observe them deposit any honey in the cells. We are also of opinion, that they are not furnished with organs proper to discharge

charge it, as the bees are ; for in bees, if you squeeze that part of the body where the honey-bladder lies never so little, it will presently come out at that part of the head, through which they are wont to discharge it into the cell : but it is not so with the drones ; though after you have opened them, you will find their bladder full of honey.

There are hives wherein you have but few drones, but there are a great many in others ; they continue for part of the summer dispersed in the hive : After which, as their number increaseth, they draw together in troops in several parts of the hive, where they continue cantoned, almost without making any motion.

When the swarm goes out, and all the bees are in motion, the drones keep their station, and go not forth with the swarm ; or if they do, they are but a very few. But from the end of *July* to the middle of *August*, these drones are attacked by the common bees ; and though the drones are bold, and resist as long as they are able, yet they are at last forced to yield, and go out of the hive, and we know not what becomes of them.

When this kind of fight happens, you may see all these animals in great motion, as well without as within the hive, much in the same manner as when they swarm : all these drones are so universally expelled, that of several hundreds which we have often found in one hive, we could not, by the end of *October*, discern one in the several hives we searched upon that account.

We have in the spring and summer-time seen a great number of small worms in the cells, though we could not find any drones in the same hive, notwithstanding all the care we took to examine them.

They have the same origin with that of the other bees, and they proceed from the queen, and are produced with the same circumstances, except only that the

the drones are bred in such large cells of the honey-combs as are made on purpose for them.

It has been already observed, that a hive has some combs, whose cells are one third or one half larger and longer than the common cells. The queen makes choice of these great cells, in order to lay therein, (with all the circumstances we have already noted concerning the common bees) those eggs which afterwards become drones, and which you cannot by your eye distinguish from the common eggs: but it is likely that the parent who produces them knows them, because she assigns them habitations in proportion to that bigness they are to attain to in their full growths. These drones are subject to the same changes we have related concerning bees: they are as many days before they come out of the cells; they are stopt up the eighth day after their eggs are deposited in the cells; but their covers are much more raised, the more to lengthen the cells, and to make them as long as the drones.

Finally, they are fed with the same care as the common bees; but it is amazing, that this attention and love which the bees shew for these young ones, should be turned into so great a hatred at the expiration of the summer: this hatred is so universal, that they do not spare even the young drones that are yet imperfect in the cells: for we have seen several times, that when one party of the bees are driving the great drones out of the hive, there is another employed to open the cells, where their imperfect drones are lodged, in order to pull them out from thence, to kill them and convey them out of the hive, where we have sometimes seen two or three hundred killed of young and old.

A description of the inward parts of the drones. The conformity there is between the inward parts of the common bees, more particularly as to the head, breast, and

and the beginning or fore-part of the belly, and those same parts in the drones, is such, that we have not been able to discern any difference between them; for the trump and breast, both of the one and the other, are much the same as to bigness; and they have all of them a bladder in the belly, of a very delicate texture, which is the receptacle of the honey; also the intestines seem to be of the same structure, except only the parts situated at the extremity of the belly, which are very different from those of the bees. We have observed before, that common bees have in that place a little bladder full of a clear and transparent liquor like water, which is the poison they discharge by the sting, through which it passes, and comes out near the point of it: but the drones have neither sting nor bladder; they have in this part of the belly some other parts that seem worthy to be taken notice of, and which perhaps will lead us to understand the end for which nature has designed them.

The belly of the drone, towards its hinder parts, is divided into two unequal parts, by a kind of a whitish and very thin diaphragm; that towards the head is smaller, and the other towards the hinder part larger: in this last part the intestines are contained; which, on one side, have a communication with the honey-bladder; and which, after having formed several foldings immediately under the back, and round the parts we are about to describe, terminate at the anus.

We may observe four glandulous cylindrical bodies under the intestines, which being round at one end, each of them is separately invested with a membrane; they are ranged two and two upon one another; the two lowermost are commonly the biggest, and are disunited, except at one end, where they join together in a point, and both of them form one common and very narrow channel: these two bodies are about the third part of an inch long; the other two bodies

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are shorter and smaller, they are also cylindrical, and are joined by a kind of pellicle to the larger ones near the hind parts, where the great ones join together.

Though these two bodies are commonly smaller than the two former, yet we have also found them in different drones to be often almost equal; and in this condition you will find all four of the same colour, which is bright and somewhat inclining to yellow; when the two lowermost are thicker than the rest, they then contain a glewy, whitish and liquid matter, which appears through the thin coat that incloses it; but the uppermost always retain the colour we have mentioned before.

If you press those two vessels when full of this matter, you will force it through the common channel before mentioned, along which it passes to the hind part, and so out of the body of the drone; but when these bodies are not equally filled with this matter, you cannot press out any liquor at all.

This channel in the drone's body is folded into several plaits, but does not take up above a quarter of an inch in length; though when it is unfolded, and at its full length, it is about an inch or somewhat more, and has all along different conformations and capacities: it is a very narrow cylindrical channel at the rise of it, about half an inch long or a little more, of a very fine texture, and easily broken; after which it grows considerably bigger to the extent of a quarter of an inch; the first half of which retains the same fine and delicate texture, but the other part of this channel is of a more remarkable structure.

There are two bodies that are almost triangular, equal, of a horny consistence, thin, crooked, and of a dark-red colour, which form part of this channel; these we call wings, because they somewhat resemble them: the two sides of each of these wings along the channel, are somewhat different, and terminate in a very sharp angle; the third side following the

the breadth of the same channel, makes but about one third of the others; the two wings lie almost back to back throughout the length of the biggest of the sides, and are not separated here any otherwise than by a small space taken up by the continuation of the common channel which joins them together. These wings are so well united to the channel, that it may be said it is the channel itself that is stiff; there is only one part of the sharpest angle that is separated and embraces the channel. Besides these two wings which are of a horny consistence, there are two others which are smaller by half, of the same colour and substance as the former, and situated on the side of each of the preceding ones; these arise in that part of the channel which answers the middle of the two first wings, and terminate with them almost in the same place: those four wings take up but a part of the compass of the channel, the other being the channel itself continued; but here it seems to be strengthened by some muscular fibres, which have their origin in the same place where the channel grows wider, and terminate at the ends of the wings, which are indented, and to which these fibres seem to be fastened.

The channel is of the same consistence as before at the extremity of these wings, except that it is narrower and flatter; for it would appear larger, according to the horizontal and vertical diameter. This part of the channel, which is no more than the twelfth part of an inch about, terminates in a bag, at the end of which there is a figure resembling a double cock's comb; that is, it is a little hollow in the middle, indented round, and admirably regular; the greatest points being towards the end of the bag, from whence they come diminishing on both sides even to their origin. There is a communication between this bag and the channel; for in squeezing the channel, the matter contained therein enters into this bag, passes through the cock's comb, fills all its eminences, and

at length goes out near the hole of the bag through which it went in; here there seemed to me a double channel, one for the matter to pass in, and the other to go out at.

The continuation of the channel, immediately next the bag, is of a stronger consistence, and almost muscular; this part of the channel is not above the eighth part of an inch in length, and it has all along on the outside four rings placed at equal distances from each other. These parts or rings surround but one half of the channel, and they are muscular, reddish, raised on the outside, and thicker towards the middle than the ends.

On the opposite side of the channel, where these parts of the rings terminate, there is another body of a horny consistence and reddish colour, which takes up but a small part of the circumference of the channel; it is a kind of an ellipsoid, raised up towards the middle, and flat towards the edges; and extends more in the length than the breadth of the channel.

To help this body on the same side of the channel where the parts of the rings are, there is also another reddish muscular body, five or six times broader, and longer than the former: from these bodies to the right and left arise two strait long muscles, which are applied to the channel long-ways, and whose ends unite with the parts of the rings above mentioned.

These same bodies do not embrace the channel throughout; but where they cease, there are two other muscular flat bodies of a reddish colour, that run along the channel, and come out like two ligaments, which are fastened to the lower part of the belly, on the inner sides of the crust which covers the drone: finally, the end of this channel terminates in the crust of the drone, and ends in an orifice, through which the matter contained in the two cylindrical bodies is thrust out, after it has passed through all the parts of the channel we have been describing.

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It often happens, when you hold drones between two fingers, without pressing them at all, that they will burst with a noise; and that this channel, with all its parts, will come out at the anus, which presently occasions their death.

Though it is difficult for us to know exactly the use of those parts, we may however say, with some probability, that they appear to have been formed for propagation; and as we are confident that the queen or king, which may be easily distinguished from the drones by its size and colour, is a female, we may say that the drones are males.

Upon this supposition of the four cylindrical bodies, of which we have spoke before, the two small ones inserted in the two biggest, may serve for testicles, and the two biggest for seminal vessels, where the liquor contained therein, and which is the seminal substance, is brought to perfection; this matter coming out of the two little bladders that are between the long and the straight channel, passes from thence into the large one, to which the four wings are fastened.

It is easy to conceive, that when the two glandulous bodies are filled with this matter, that it glides and passes through the narrow channel, and from thence into a bigger; but that it may afterwards enter from this great channel into a narrower, it is necessary that the liquor should be compressed; the four wings on the inner sides of the large channel coming near one another by means of the fibres which are joined to their ends, may press this matter on the great channel, and cause it to pass into all the parts of the bag and folds we have mentioned, which subtilizes and makes it more perfect; those parts of the four muscular rings which below the bag encompassed some of the external parts of the channel, and whose ends are fastened to the longitudinal muscles, may compress the channel, and squeeze the matter out of it. The two muscles which come after may serve instead of a sphincter,

sphincter, and close up the channel; the other two long muscles, which are fixed to the inner sides of the drone, may perhaps be the former's antagonist, and serve to open the same channel, that the matter may pass which teems or impregnates the female's eggs.

We have not hitherto been able to discover in what manner this impregnation is brought about, whether it be in the body of the female, or after the way of fishes, when the female has spawned: the whitish matter that encompasses the egg in the bottom of the cell soon after it is laid, seems to carry it in favour of this last opinion, as well as the remark which has often been made concerning a great number of eggs which have produced nothing in the bottom of the cell, and about which no such substance has been observed.

From some observations made at different times, it has been conjectured, that drones contribute nothing at all to the generation of bees; for, upon the examination of several hives, not only in the autumn, after the drones have been driven away by the bees, but also in summer-time, when we have found in the hives a great many eggs and young bees inclosed in the cells, we met with no drones. But by a late observation we have made, there is room to believe, that there might be some drones in those hives, though we have not been able to distinguish them from amongst so many thousand bees: but upon a more nice inquiry, we have lately observed a great many drones that are much smaller than those taken notice of before, and which exceed not the bigness of small bees, insomuch that it would be no easy thing to distinguish them in the hive from common bees, without dissecting them, or very close examination: and it might very well be the case, though we could find no large drones in the hive, that yet some of these small ones intermixed might be such, and pass undistinguished among the rest of the bees, since we knew not before that there were any of that size.

All the cells of the hive, where these small drones are found, were little, and there were no large cells to be discovered (c).

An

(c) Let the spot pitched upon, for placing the bee-hives in, be not far from the house, and be well defended from winds every way. The best security of this kind is by proper hedges, and these should be so contrived as not to keep out the sun; for the bee requires warmth as well as stillness. The best situation is, when the house or some large building stands to the north, that it may be perfectly defended on that quarter; and the opening is to the south, to let in the best rays of the sun. There should be also some trees pretty near to receive them at the times of their swarming. The place being thus chosen, let there be set a parcel of stools for the hives to stand upon. The usual method of setting several hives together on a bench is not so well, as it occasions a great deal of confusion among the bees, who often mistake one hive for another, and thereby quarrel about it, and do one another a great deal of mischief. The stools should be made of wood, for when covered with stone, they are too hot in summer, and too cold in winter. They should be raised about a foot or a little more from the ground, and placed not exactly upright, but a little slanting, that the water which falls on them may run off. On the top they should be about an inch broader than the bottom of the hive, and in front, just before the door of the hive, they should have an extent of the bigness of one's hand, for the bees to settle upon, when they come home loaded: these stools should be set in a row from west to east, a little inclining to the west. The bees being kept dusky and sheltered during the winter, the doors are to be thrown open early in the spring to promote their industry and breeding. At the time of the bees swarming the hives are to be rubbed with thyme, hyssop, or bean-tops, and it is a good method to rub a little honey on the inside. The hives are to be plaistered down to the stools with a mixture of cow-dung, sand, and a little lime.

The swarming of bees depends upon many accidents, and none affects this more than the weather. In a mild and calm spring, they swarm early. In a cold and backward season, they do not swarm well, and what they do in it is later. Sometimes in extremely hot and dry weather they

will

An explanation of the remaining figures in Plate III. relating to bees. Fig. 1. The queen of the bees, according to her natural size. 2. The drone the same.

3. The

will be so continually out, and so many of them together, that they do not perceive the fulness of the hive, which will prevent them from swarming, but the owner should take all opportunities to force them in, in good swarming weather, when they lie out at the door. Those which hang about the stool may be gently moved off with a brush, which will cause them to rise, and the noise of several of them flying together will sometimes call up the others and make them swarm. One swarm not sufficiently unloading the hive, eight or ten days afterwards there is another swarm ready, and when the first swarm happens to be broken, the second will sometimes come the next day, and after this there will come a third, and sometimes a fourth; and all this usually in the space of fourteen or fifteen days.

When they swarm, all that is to be done is to let them be quiet while they are about it, as all noise disturbs them, notwithstanding the preposterous practice in the country of ringing upon a kettle or pan. If there be any danger of wandering, a little dust is to be thrown among them, which never fails to quiet them, and to bring them down. When it happens that the swarm parts, if they be within sight of one another, the best way is to disturb the lesser cluster and they will go to the greater.

When the swarm have fixed upon the place where they shall light, they soon begin to cluster together, and when they are well clung one to another, they are in a condition to be got into the hive, which should be greater or smaller according to the bigness of the swarm. In order to their hiving, let there be a cloth spread upon the ground near the place where the bees are settled, and the hive laid upon it; and if they happen to light upon the small bough of a tree, let it be cut gently off, taken down quietly, and laid on the cloth, and the hive set over it: but when the bough is too large to be cut off, or that the bees are otherwise disposed, so that this method cannot be taken, let the husbandman shake them off into the hive, and then set it upon the cloth. If they light on the ground, the best way is to draw the cloth under them, and then shaking them off cover them with the

3. The bee the same, 4. The basis of the cell in its horizontal situation, that you may have the better idea of the form of the egg as soon as it is laid, and in what

the hive. When any number gather at any small distance from the hive, let them be moved gently towards it with a brush, and the place rubbed with something disagreeable to them, as wormwood or stinking may-weed. Sometimes the swarms come late, and are small; the best of them not sufficient to fill the hive: in this case two or three of them are to be put together in one hive. The method of joining these several little swarms is this. Near the stool where the united swarm is to stand, spread a cloth upon the ground, in a calm still evening, when it grows dark: then set two supporters for the hive, and knock down the hive out of which the bees are intended to be removed; then lift it up, and clapping it between the hands, lay it down on one side by the bees, and over them set the swarm to which they are to be added, placing their hive upon the supporters.

When an old stock of bees is to be removed from one place to another, the beginning of *October* is the best time: but it may be done in *February*, or any time in the winter, but fair and still weather is the best time for doing it, and in the evening, while the bees are quiet. Bees should be fed when their own store fails, and this is not only proper in winter, but also in spring, when the stock of honey is generally very small. The best way of doing this is, by conveying the food in a cane, or little trough, into the hive. Many kinds of food have been contrived for them, but the best is found to be a mixture of honey with sweet wort, or new beer and a little bay salt. Quiet is a great article in the care of bees: therefore all noise and disturbance are to be as much as possible kept from them. Smoak is also very destructive of them; and all bad smells do them harm and render their habitation disagreeable.

The end of *August* is the time for taking the honey, at which time, the husbandman is to consider what he will keep and what he will kill; the best to keep being those of one or two years standing, or those of three or four years. The swarms of two or three years old, which have cast their hives, are to be killed, because they are not like to continue; as are also those poor swarms that are not worth the feeding, and all light stocks. *Compleat Body of Husbandry.*

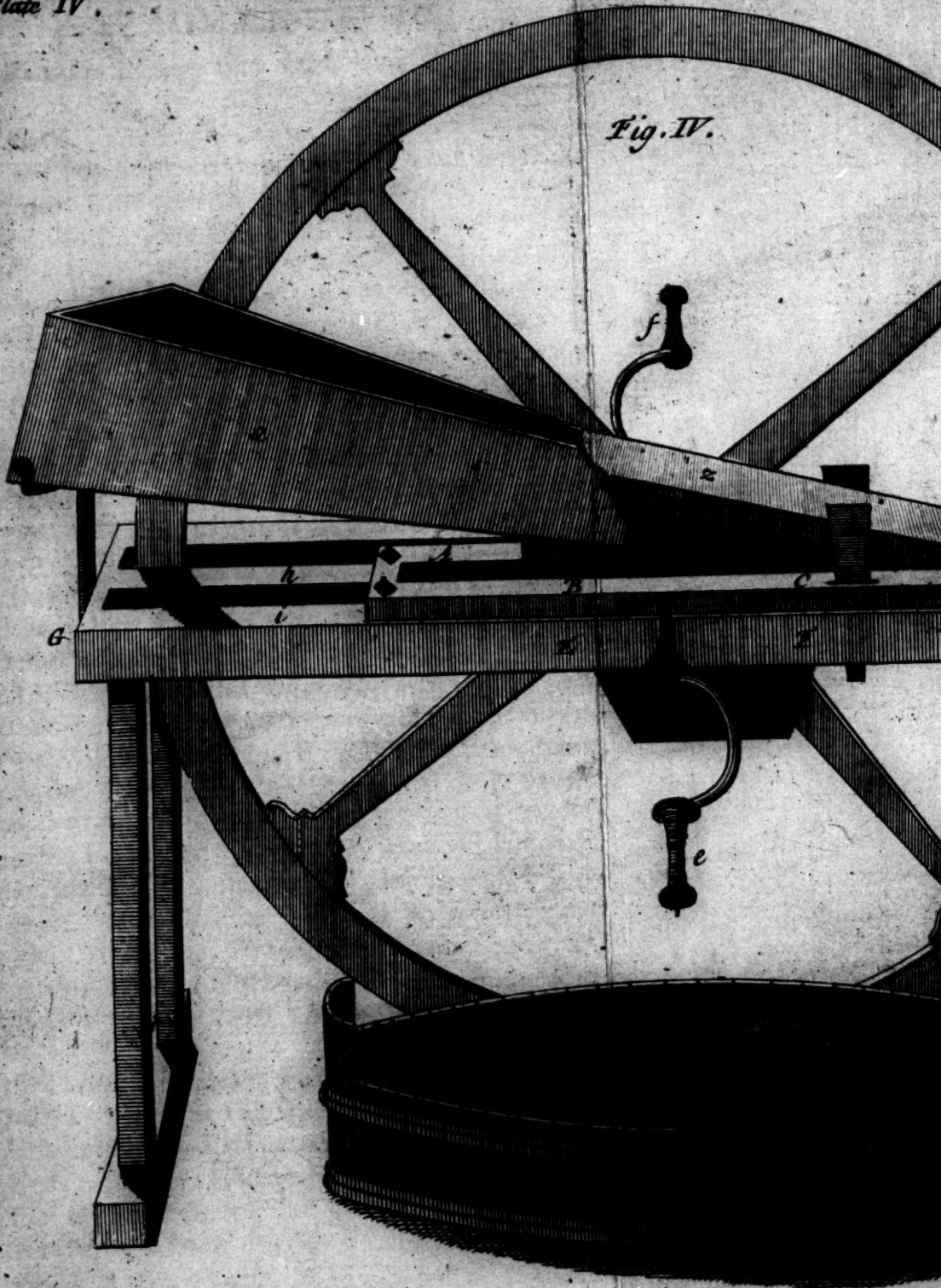
what manner it is usually placed upon the basis. 5. The basis of the cell in its vertical and natural situation, with the egg changed into a worm or caterpillar, and encompassed with a little liquor four days after it is hatched. 6. The worm, according to its growth eight days after it has been hatched. 7. The same worm ten days old, after it has altered its shape and situation. 8. The same worm changed into a young bee that is bigger than ordinary: but is yet white and soft. 9. Part of the honeycomb, which represents how the cells are ranged in the two opposite sides of the comb. 10. A piece of a honeycomb, representing the cells on the inside. 11. Several cells whose sides are taken away, where we only see the bases: this figure gives us to understand how these bases are ranged with respect to one another; and in what manner the two orders of cells are formed in the two faces of the honeycomb: for the angle A represents the solid concave angle which is at the bottom of the cell in one face of the comb. The angle B and the rest of the same order shew the solid angle, which is convex in the same face of the comb, but concave in the opposite one, and found at the bottom of the cell opposite to the former.

CHAP. XI. *A description of a mill for making cyder, with twelve bushels of apples to each hoghead. Invented by Edmond Browne of Redborough, Esq; in Gloucestershire.*

I Need say very little in commendation of the above mentioned curious gentleman's invention, for making an hoghead of cyder with twelve bushels of apples, since it is so well known, that the common allowance of apples for an hoghead was twenty, and sometimes two and twenty bushels; so that by this invention

there

Fig. IV.



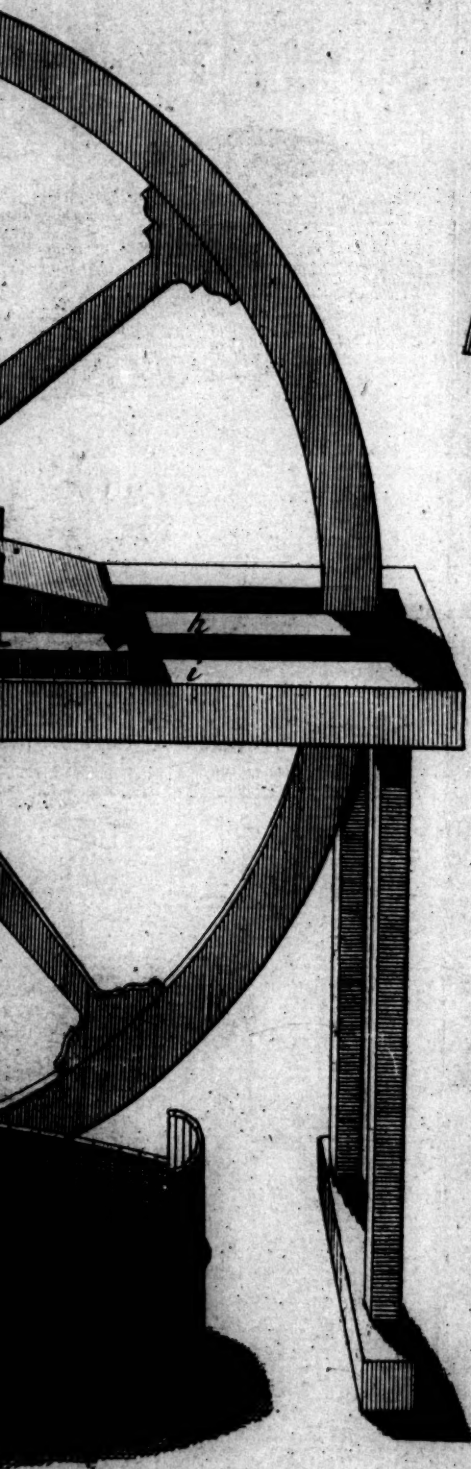


Fig. I.

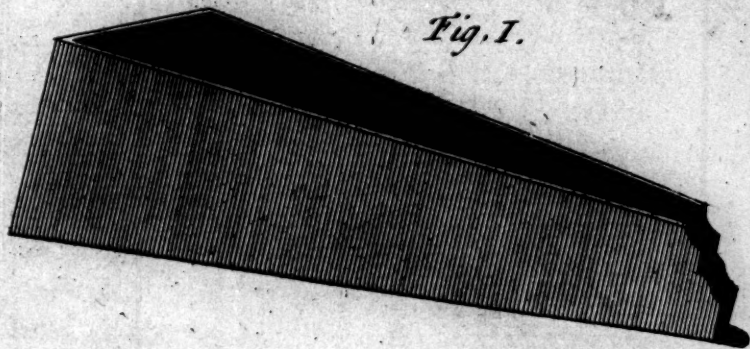


Fig. II.

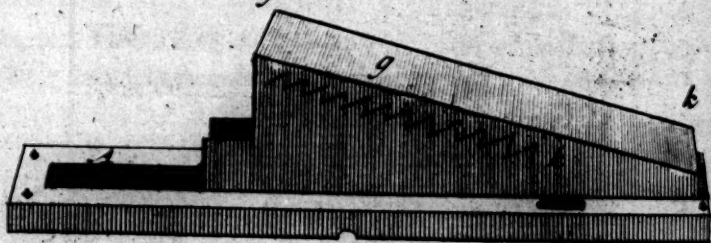
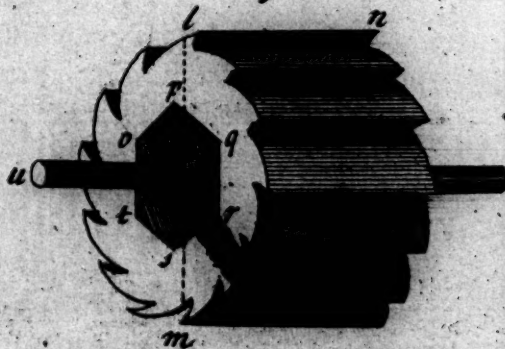


Fig. III.



there is at least one third part gained upon all the cyder-ground in England.

Explanation of the mill for grinding apples. Plate IV.
Fig. I. represents the bin or trough whereinto the apples are poured, in order to their being tumbled down between the rollers to be ground. This bin is furnished with a tongue *a*, *Fig. IV.* that enters into the box, *Fig. II.* the better to guide the apples to the rollers; and the tongue is lodged upon a rest, placed within at the mouth of the box, in such a manner as that the end of it may hang directly over the top of the roller *b*, *Fig. III.* but so as not to touch it; the person that grinds at the handle *e* of the mill, is with his left hand to feed the mill, and govern the apples, that they may tumble into the rollers in a just proportion, and not choak.

Fig. II. is a box to be fastened down (by its frame *A*) with screws or keys upon the pieces *b* and *i* of the mill, *Fig. IV.* to protect the rollers and confine the apples. The top-board *g*, of this box, is to be furnished on the inside with teeth or furrows, represented by the pricked indentings *k k*. The use of these furrows is to crush a larger sized apple (at its entrance) against the roller *b*, *Fig. IV.* that it may not refuse to be taken in between the rollers *b* and *c*. This top-board should therefore be elevated to such an angle with the frame of the box, as that it may be at a proper height from the roller *b*; and also so near to the roller *c*, as just not to touch it; thereby to prevent any parts of the apples from getting over and beyond the roller *c*.

Fig. III. represents a roller drawn to a larger scale, (with thirteen teeth) the diameter *l m* is seven inches, the thickness *l n* four inches and a half. The whole being of cast-brass or bell-metal, except a cavity through it, represented by the hexagonal figure *o, p, q, r, s, t*, which is filled up with wood, wherein the iron-axis *u u* is placed. The angular figure of this wood

wood prevents its loosening or turning round within the metal.

Fig. IV. is the mill joined in all its parts, wherein *a* is the bin, supported behind by a rest *w*; *z* is the box screwed on by its frame *A*, to the pieces *b* and *i*; if you suppose the side of this box transparent, the roller *b* and *c*, which are of equal bigness, and represented by dotted lines, will be seen through it. The roller *b*, turned by the main axis whereon the wheel hangs, drives the roller *c*, which runs in brass collars lodged in little blocks of wood, moveable to and fro, in hollow channels made on purpose in the pieces *b* and *i*. The design of placing this roller on these moveable blocks, is to give it liberty to recede more or less, as there is occasion, from the roller *b*. The quantity of this recess is adjusted by the wedges *d d*, which pass through mortices made for them, and whose sides are contiguous to the ends of these blocks. Whilst the apples are whole we give the rollers the more liberty, by raising these wedges, but when we grind them over again the second time, after the first pressing, we confine the rollers more, by forcing the wedges down. The rollers are to be so placed, that, when they have the most liberty, they may but just run free between the pieces *b* and *i*, and the sides of the frame of the box, and two cross bits of wood lodged and fastened in the inside of the same frame, about the place *B* and *C*; to the intent that no big pieces of apple may drop through unground: *y* represents a hollow conveyance, or mouth, placed under the rollers, to deliver the ground apples into the receiver or tub *x*; the handle *f*, which a second person turns, is placed so as to be elevated when the other is depressed, that the force may be the better, and the more equally exerted. The pieces *b* and *i* being pretty long, it is proper, in order to keep them steady, and prevent their swerving, to connect them together by cross stays, or bits of wood, about the places *E* and *F*.
The

The handles *e* and *f* are hollow wooden tubes riding on iron spikes. The height of the frame of the mill, from *G* to the ground, is about three feet.

The author's method of making cyder. After grinding, I squeeze my apples very hard with a strong screw-press, wrought with a capstern, in hair-cloths, reeved or drawn into the form of a circular bag, by means of strings or loops, four or five bushels at a time, in as many bags, with a round board two inches thick put between each bag: these boards are made of an inch-plank nailed together cross-grained. When the apples are once squeezed, I order the cakes or cheeses to be rubbed to pieces, and ground and pressed over again; and if this were to be repeated even a third time, it would answer the pains, for it would procure liquor enough to pay the wages of two men for a day; that is, to defray the charges of the labour of your cyder making. Twelve bushels of apples heaped (which is the usual way of measuring apples) will by this method most commonly yield more juice than will fill a beer-hoghead: about two thirds of the liquor runs out at the first pressing, the remaining third at the following ones.

CHAP. XII. *Concerning the improvement of land by timber; with extraordinary observations relating to the propagating of the fir-tree, and its kinds.*

To Mr BRADLEY.

SIR,

I have been, for many years, a professed lover of husbandry, as I think it not only the most innocent, and most healthful amusement in the world, but what, if rightly followed, may be of great profit to particular persons, and of advantage to the public in general.

neral. As that is the case, without further introduction, I shall make the fir-tree the subject of this letter, which is (for aught I can see) very much a stranger to *England*. I am a *North Briton*, and have seen their way of managing them there, where they not only have great woods of them, that grow naturally upon mountains, and (as I am told) are fit for masts to the largest ships, but the gentlemen there have of late years made great plantations of them. At first they were fond of them because of their keeping their leaves all winter, and being continually green; but as they lose much of their beauty when they pass twenty years of age, especially by the unmerciful pruning that was formerly in use, which made them top-heavy, and so yield to the wind, even so as to break them sometimes; the outermost rows always were crooked. At last gentlemen came to plant them at a far greater distance from their houses, in which case their colour make a fine shew through the whole year, and their rugged bark is not so easily seen; so that now there are, for the most part, thickets of other trees betwixt the house and the firs. And indeed I would advise a good thicket of firs to be planted round any place where one would incline to have other trees thrive well. But consider, Sir, that I am speaking of *Scotland*, where the winds are more frequent and violent than in *England*: so that was any body to begin a plantation, I would advise them to plant round the field a good number of firs, even before he sowed a seed of what we call grey-timber; and these ordered as I hope to shew you, I dare say will give such shelter to the rest, as will much advance their growth. I shall now begin with the gathering the lones, clogs, or apples, for these are the names that we have for them: they are fit for pulling in *January* or *February*; and if they hang upon the trees till the frosts are over, the first sunshine opens them, and then the seed is lost. We can be at no difficulty in getting of them now, because
there

there is scarce a gentleman's house where there are not fir-trees; but some time ago all the planters were in a great deal of hurry to get the clogs opened, that so the seed might be got ready by the end of *March*, or beginning of *April*; but our weather not answering some years, disappointed the planters extremely, so that I have seen the clogs put under hot-bed glasses; others laid them at a distance before a fire, with persons always at hand to turn them, and every five minutes to sift the clogs with a wire sieve to get out the seed. These ways did pretty well, but were troublesome, and the last way dangerous; others put them in an oven, or upon a kiln; but these last ways perfect errant cheats, since the seed was overdried, so that it proved good for nothing. At last an old gardener, who long had dealt in fir-seed, made the following experiment: he gathered the clogs at the ordinary time; laid them up in a cool dry place, where they got neither moisture nor the heat of the sun; till the end of *July*, or beginning of *August*; at which time he laid them out to the sun, by which means they opened more in one day, and a great deal kindlier, than what could be done in a month any other way; the seed he carefully kept in a dry cool room, and then in the spring he had it fit for sowing what time he pleased, as the spring was later or forwarder. You see by this method it would be no difficult matter for the timber-merchants to bring the clogs from *Norway*, though we having the tree amongst ourselves are not at that trouble. The best way of sowing them, is in ordinary ground of natural earth, not forced nor poor; the earth turned off with the back of the rakes till the seed is sown, which must be done pretty thick; then the earth drawn on again, and raked very gently till the seed is all covered: some days afterwards it will not be amiss to sift upon the beds, some more mould, free of stones or gravel.

Your

Your correspondent Mr *Waller's* frames (a) are not only a good, but I think a necessary way, since the frames in a few years will be much cheaper than hiring men to chase away the small birds (especially the gold-finch) from the beds, who are so greedy of the seed, that if it is not guarded, your nursery will soon be picked up. Before winter comes on, it is absolutely fit to throw some saw-dust, chaff, or something of that kind upon your young plants, to preserve them from the frost, which otherwise would swell the ground, and so spew them up. In *Scotland* they used coal-ashes, which I thought too hot, and rather chose the other way. If the seed has been good, and sown thick enough, there will be no occasion to weed the beds the next year; if it has not, they must be weeded, but very carefully, lest the young plants be pulled up. When they have been two years in the ground, from the sowing, they must be removed. In our country it was the custom to put them in nursery-ground, at about a foot's distance, where they were to be kept clean from grass, weeds, &c. for two years more, and some have kept them a great deal longer, though I think with very little success, which was both troublesome and expensive. But some gentlemen made trials of removing them from the seed-bed to the place where they designed they should always stand. Their method was this: having got the pits ready, with the earth filled in, they drew as many young firs as they thought they would be able to plant in a day; the roots of these they dip in a tub of earth and water mixed together till it be pretty thick, and lay a handful of this pap upon the roots, to keep the ~~air~~ from drying them; one man can carry a great many in a basket: when they come to the pits, they plant them with a dibble. They found by this practice, that fewer

(a) See Chap. 3. Part I,

fewer firs misgave than when they were put in nursery; and you may judge what trouble and expence were saved. At the same time, I must tell you, that at present very few firs are planted with us, except it is in heathy, poor, sandy, gravelly, or rocky ground, where nothing else is likely to grow; if they are planted in a richer soil, either for their beauty, or to be a shelter to other trees, they must be weeded: but now I shall give you an account how we use them in our poor grounds, where weeding is altogether needless; and by the by, I must acquaint you, that a fir will grow as fast, in a poor hungry soil, and I believe turn out better wood, as in a rich one. The way I would chuse to plant them is at four feet's distance, without attempting any regularity, since I think them only fit for thickets, and not for walks. I do not believe that they will ever come to be great trees, if they are allowed to stand thus thick; but this I know, that when they are planted close, they assist each other in growth. When they grow troublesome by their nearness, it is easy to prune branches from a few of them, which will give air, by degrees, to the rest; and doing this yearly, you may cut down some of them as you see occasion: but I would not chuse to prune a fir that I designed for timber, since our best and only fir-timber comes from countries, where I dare say they never were touched with iron, till they were felled. And I reckon that the reason which makes the timber that gentlemen cut down so full of knots, is the pruning; for if firs are allowed to grow close together, the great boughs in time will grow smaller by want of air and nourishment: so that I have remarked a low bough, as big as my leg, wither till it grew as small as my finger, and then drop off; hence I believe, that by this means the great knots will not be found in these trees, when they are cut down. I have now in a superficial way given you my opinion as to the method of propagating this tree,

O

which

which I am sorry to see so little regard had to in this country, considering that it is so easily to be had, and that there is no ground so barren in which they will not thrive; they are green all the year, and what demand there is for that timber from abroad is pretty well known. I have been surprized to see such wild wastes where these trees, (if they had not been despised) might have now made a fine figure, and been of great profit to the country (b).

I am, Sir, Your most humble Servant,

JOHN EDENBRUGH.

Some

(b) The manner of propagating fir, pines, and other trees of that kind * from seeds is this. The ripe cones of these trees are to be either exposed to a gentle heat, or soaked for twelve hours in warm water; after which the several cells will open, and the seeds fall out.

These seeds should never be taken out till the time of sowing them, which is *March*. The ground they are to be sown in, must be carefully turned several times to destroy the roots of weeds. For a large plantation, this is best done by ploughing several times; after this, the earth is to be levelled with a spade in small spots at every six feet square; in each of which spots, ten or twelve seeds are to be sown, and covered with some of the same mould broken fine but not sifted; then they are to be covered with a furze-bush or other such covering; and this is to remain for some time after the plants are come up, but they must not be covered too close by it; when this covering is taken off, a little loose earth is to be drawn about the stems of the plants, and a little furze stuck about them, to keep off the too great heat of the sun. Usually from twelve seeds there are eight plants or thereabout, and these may be left standing together, till the third year. In *March* or *April* the third year after sowing, the plants are to be removed to the place where they are to stand, and planted at eight feet square distance, or greater, if desired. Two plants should however be left in the

* The *Scotch-fir*, as it is commonly called, is reckoned a species of pine, and is, consequently, by all botanists, referred to that genus.

Some material points concerning the planting and pruning of fruit-trees.

Richard Bradley,

Being a constant peruser of thy monthly books, I perceive by these, and thy other learned works, as well as by experience, that the true knowledge of the pruning of trees, is the greatest art required to make a compleat gardener. I am master of a small plantation of fruit-trees, situated in a good soil, exposed to the south, fenced by a hill and an old castle from the north and east; but notwithstanding these blessings of nature, I cannot have any quantity of fruit, though my trees never fail of having a great quantity of blossoms. This I impute to their being too luxuriant, and running too much into wood. I have cut off a great many branches; I have brought them to fine heads; I have scarce left any branches

O 2

but

the plantation in each cluster, and great care taken not to injure the roots of these. The others also must be taken up with as much earth about their roots as possible. When they are set in the new plantation, there must be stakes fixt near them to tie them to, that the wind does not blow them down, and the roots must be covered with litter, and they must have a gentle watering to settle the earth to their roots. If the weather prove very dry, this may be repeated two or three times, but a little at a time; over watering kills all new set trees, and the cutting any of the heads or branches of these of the resinous kind is a very dangerous thing.

The *Scotch*-pine delights in a chalky soil on the side of a hill, but will also grow in gravel, and in any ground that is not too wet.

The common fir loves a loamy strong soil, and is a native of low flat grounds; and most of the *American*-firs and pines, love a loose moist soil. The silver-fir, and the manured-pine, love a dry situation, but must have a deeper soil than the *Scotch*-pine, and must be sheltered from the north winds. The two trees left in each spot of the place where they were sown, may be left together seven years, then the least flourishing tree is to be carefully removed. *Miller.*

but what grow horizontally; and yet I find from experience, that my labour in a great measure is lost.

I find that *John Warner* has a different way of pruning trees, from that recommended in thy books, or practised by any person else that I have heard of before, which never failed to bring plenty of fruit. His way of pruning his trees is so easy, so ornamental, and so consistent with good sense, according to my mean capacity, that I was soon induced to believe what he told me.

Thou hast seen his garden; he has two long canals planted on each side with dwarf-trees; his soil is very good, his trees very luxuriant; he never could bring them to bear fruit by the ordinary way of pruning; but since he has made use of this new method of pruning, he told me he never missed of having every year great plenty of fruit. *John Warner's* method is this: he lets two, three, or four of the straightest and largest branches grow up a yard or two higher than the tree; these he prunes closely all over. I imagine that these maypole-like branches (for they resemble maypoles) carry off the super abundant sap, that formerly hindered the trees from bearing, which could not be done by the common way of pruning. He tells me, that by this way he never fails of having plenty of fruit: experience is the best master, and cannot be contradicted (c).

My

(c) There is not any part of gardening which is of more general use than that of pruning, and yet it is very rare to see fruit-trees skilfully managed: the knowledge of pruning requires a strict observation of the different manners of growth of the several sorts of fruit-trees; some requiring to be managed one way, and others in a quite different method: for some sorts produce their fruit on the same year's wood, as vines; others produce their fruit, for the most part, on the former year's wood, as peaches, nectarines, &c. and others upon cusions or spurs, which are produced upon wood of three, four, or five, to fifteen or twenty years old, as pears, plums,

My friend, thou art very knowing in natural secrets of this kind ; I should be glad to have thy opinion on the subject : if thou approvest of this practice as beneficial

plums, cherries, &c. therefore, in order to the right management of fruit-trees, there should always be provision made to have a sufficient quantity of bearing wood in every part of the trees ; and at the same time, there should not be a superfluity of useless branches, which would exhaust the strength of the trees, and cause them to decay in a few years.

The reasons which have been laid down for pruning of fruit-trees are as follow. First, to preserve trees longer in a vigorous bearing state ; the second is, to render the trees more beautiful to the eye ; and thirdly, to cause the fruit to be larger and better tasted.

The general instructions for pruning are as follow : the greatest care ought to be taken of fruit-trees in the spring, when they are in vigorous growth, which is the only proper season for procuring a quantity of good wood in the different parts of the tree, and for displacing all useless branches as soon as they are produced, in order that the vigour of the tree may be entirely distributed to such branches as are designed to remain. For this reason, trees ought not to be neglected in *April* and *May* when their shoots are produced : however, those branches which are intended for bearing the succeeding year should not be shortened, during the term of their growth, because this would cause them to produce two lateral shoots from the eyes below the place where they were stopped, which would draw much of the strength from the buds of the first shoot : and if these two lateral shoots are not entirely cut away at the winter-pruning, they will prove injurious to the tree. This is to be chiefly understood of stone-fruit and grapes ; but pears and apples being much harder suffer not so much. It is likewise to be remarked that peaches, apricots, cherries and plums, are always in the greatest vigour when they are least maimed by the knife : for where large branches are taken off, they are subject to gum and decay ; it is therefore the most prudent way to rub off all useless buds, when they are first produced, and to pinch others where new shoots are wanted to supply the vacancies of the wall, by which management they may be so ordered as to want little pruning in winter. The manage-

neficial to the public, recommend it to thy friends ;
in that thou wilt very much oblige,

Thy unknown friend,

R. W.

The

ment of pears and apples is much the same with these trees in summer, but in the winter they must be very differently pruned ; for as peaches and nectarines do for the most part produce their fruit upon the former year's wood, and therefore must have their branches shortened according to their strength, in order to produce new shoots for the succeeding year ; so, on the contrary, pears, apples, plums and cherries, producing their fruit upon spurs which come out of the wood of five, six, and seven years old, should not be shortened, because thereby those buds which were naturally disposed to form these spurs, would produce wood branches, by which means the trees would be filled with wood, but would never produce much fruit.

The branches of standard fruit-trees should never be shortened unless where they are very luxuriant, and grow irregular on one side of the tree, attracting the greatest part of the sap, by which means the other parts are either unfurnished with branches, or are rendered very weak ; in this case the branch should be shortened down as low as is necessary, in order to obtain more branches, to fill up the hollow of the tree : but this is only to be understood of pears and apples, which will produce shoots from wood of three, four, or more years old ; whereas most sorts of stone-fruits will gum and decay after such amputations : whenever this happens to stone-fruit, which suffer much more by cutting than the former sorts ; it should be remedied by stopping or pinching those shoots in the spring, before they have obtained too much vigour, which will cause them to push out side branches, whereby the sap will be diverted from ascending too fast to the leading branch : but this must be done with caution. You must also cut out all dead or decaying branches which cause their heads to look very ragged, especially at the time when the leaves are upon the tree : these being destitute of them have but a despicable appearance, besides they will attract noxious particles from the air, which are injurious to the trees : therefore the sooner they are cut the better ; in doing this, you should observe to cut them close down to the place

The foregoing letter contains many things of consequence, which I may hereafter explain more fully. I shall at present only give some general hints concerning the management of such trees as blossom freely, and bear little fruit, and defer the entering into particulars upon this subject till another opportunity.

In that part of this work which relates to fruit I have taken notice of the may-pole branches here mentioned, under the title of waste-pipes to carry off the over-abundant sap; these I have only observed at *Mr Worker's at Rotherhitb*, and am persuaded they are of extraordinary use for bringing a tree to bear.

I do not think that leaving only the horizontal shoots of a tree, can any way put a stop to the luxuriance of it; but the bending or laying down of upright branches horizontally, checks the sap, by stopping its course through many of the vessels, and helps the pithy parts to digest their juices so as to produce flower-buds; for all buds of a tree are either leaf-buds, or flower-buds, as the pith is more watry or undigested, or more dry and tending to decline.

The pith in one year's shoot is abundant and watry.

The pith in a shoot of two years is less in quantity, and more dry.

The pith in a three year's shoot is hardly to be discerned; and in older branches is of no use, but is entirely consumed or rotted.

O. 4

Now,

place where they were produced, otherwise that part of the branch left will decay and prove equally hurtful to the tree. If the branches are large which you cut off, it will be proper after having smoothed the cut part exactly even with a knife, chisel, or hatchet, to put on a plaster of grafting clay, which will prevent the wet from soaking into the tree at the wounded part. All such branches as run across each other should also be cut off: for these not only occasion a confusion in the head of the tree, but, by lying over each other, rub off their bark by their motion, and very often occasion them to canker. *Miller.*

Now, where this pith is overcharged with water, we seldom observe any disposition to flower; or if the tree blossom, the farina which should impregnate those blossoms is so unripe that they very rarely set for fruit.

There are some soils which encourage trees to shoot large luxuriant roots: these imbibe so much water, that the shoots which answer them in the head of the tree, are overcharged with sap; and in such a case either those roots should be pruned, or some waste branches or pipes should be left growing to discharge the watry parts, as in Mr *Warner's* trees. But I should like to know what soil is in the garden of my correspondent *R. W.* and how deep it is.

It may happen that the blossoms are destroyed by dale-mists, or frosts.

Answer to Mr. R. W.

SIR, Your love for gardening is so expressive in your letter to me, that I am fond of an opportunity of lending you what assistance I can towards putting your trees in a method of rewarding your labours with good fruit. The hints which I have given on this occasion in my papers relating to fruit, are what, I think, may contribute something towards their help; but I shall now open the case a little more plainly than I did before, and that by means of experiments which I have lately made.

I have observed that trees which have been much pruned are subject to shoot unequally, that is, some parts will shoot more vigorously than others; and in some cases all the luxuriant branches will be on one side, while the bearers lie in a little compass on the other side of a tree. Now where it happens that the vigorous shoots are very prevailing over the bearing branches, the blooming ones commonly drop their blossoms, before they set for fruit; or else they drop the fruit that does set upon them, about *July*, which

which is the time of a tree's second shooting; and this for the same reason that the weaker branches of a tree are made to blossom; for the luxuriant branches, when they happen to get the better of the smaller, imbibe all they can of the juices of the tree; and rob the smaller shoots of that sap which should have supported their strength; and experience teaches us, that, by weakening any vegetable of very great vigour, we bring it to bear fruit.

Mr *Fairchild* observes very well, that when by this means one part of the tree is brought to put out blossom-buds, if the other part remains to shoot vigorously, those vigorous shoots will draw so much of the sap to themselves, that there is not enough left circulating in the bearing part to support the blossoms, and therefore they drop; or else should they not be so much impoverished at the blossoming-time as to drop them; yet when the tree comes to make its second effort in *July*, the bearing branches may then be so slenderly nourished as to occasion the falling of the fruit that was set in the spring.

Now in such a case there are many who would prune the luxuriant branches within three or four buds, to prevent this mischief; but such pruning as that provokes the pruned part to shoot still more vigorously, and there is always a greater expence of sap than there was before; and then the bearing part becomes still a greater sufferer, and often dies. When plants are thus, through ill management at first, brought to such an unequal method of shooting, I would either prune very little of the vigorous shoots, or bend them down to check their luxuriance without pruning at all; and then I judge that the circulation of the sap in the tree would become more regular; for by the checking the strong branches the weak ones would have a greater share of nourishment, and even the strong branches would be brought into a bearing state: but this is only with regard to dwarf-trees,

trees, or walls, or espaliers, where the little room we have must be employed to the best advantage; when this is our case, I think we should not so much study the great regularity or figure of our trees, as how they may bring fruit in abundance, and sometimes their look will be rude enough.

A standard-tree, if it likes the earth, has in itself a natural regularity without pruning; and we observe, that the great branches, if we allow them time, will bear well, especially if we cut some of the great roots after *Midsummer*, for those great roots are the cause of the over-vigour of the shoots: so that if pruning is necessary, I think it should be rather in the roots than upon the branches, for the earth will sooner heal a wound than the air, and when the cause is removed, the effect ceases. The sum of what I have observed in the common way of pruning amounts to this, that in much pruning there is much mischief.

I am, SIR, Yours, &c.

R. BRADLEY.

CHAP. XIII. *Concerning the facility of raising timber-trees, in a letter from Sir Henry Goodricke, wherein it appears that weeding of timber-plantations is unnecessary.*

To Mr BRADLEY.

SIR,

I Find the expence of planting one great discouragement to it, and the weeding of young plants, feeding oaks especially, to occasion the greatest part of the expence; for I found by experience, that if the plantation exceeded the extent of a grove, the weeding was endless, and the charge discouraging; and yet all treatises about planting, made that weeding to

to be absolutely necessary. However, I resolved between three and four years ago, to try an experiment, and sowed several acres of ground with acorns, keeping it fenced. I took no farther notice of it, but let the weeds grow and fall as nature guided them, and now have ordered about a yard or two square of that ground to be cleared of weeds and grass. I find my young oaks there thriving and healthy under the tall weeds, and likely to become a wood in a few years; and I doubt not but, when they shall raise their heads above the weeds, they will soon shoot away prodigiously; for though they might have grown something faster, if weeded, yet the roots may have been strengthening themselves under-ground all the while; and weeds and grass may have sheltered them from many external injuries such small plants are subject to, as frosts, droughts, the cropping of hares, &c. besides, the rotting of the weeds yearly upon the ground, must enrich the land before the increasing bulk of the trees requires more nourishment; whereas, the carrying off those weeds must certainly impoverish the soil; though the present weeding and stirring the soil may force the nutritious juices into the young plants, and thereby give them a more speedy increment now, yet hereafter, when they will require more nourishment, they are not only deprived of what they formerly had, but the soil being impoverished by the continual carrying off of what it produced annually, the trees remaining may grow mossy, stunted and hungered, and consequently never make good timber. If this method of sowing, without farther charge than only that of fencing, be approved of, then his majesty's forests (now desarts) may be replenished with wood at much less expence than I think has been proposed hitherto; and it will be a great encouragement for all large plantations, which the charge of weeding has hitherto confined in a narrow compass. I must indeed own, that all small trees transplanted must be weeded,

weeded, or they will be choaked by those weeds, which nature makes a shelter to the seedlings; therefore plantations of that kind of elm that does not bear seed, and all trees raised of sets transplanted, must be weeded.

Another observation I must mention is, that where any falls of timber have been made, and, according to the direction of our planting-books (nay, even of our laws) several young trees have been left standing, they have soon after been starved with the unusual access of the cold winds, and come to nothing; whereas, where the fall has been general, the young trees so cut amongst their seniors, have from their roots made strong shoots; and being from their first advance out of the earth accustomed to the cold, and continuing their growth with the shelter of what sprung from the roots of some older trees, have come (as I am informed by experienced men) to grow up to good timber. This also appears plainly in all plantations, that where the trees are set or sown at the distance they are designed to be when come to perfection, such trees spread their branches, turn crooked, and never grow to tall or straight timber; and that where they are thick planted, there is an emulation as it were among them, which shall outstrip each other; and when some have got the start, they soon take the nourishment from their less thriving neighbours, which less thriving trees are the properest to be removed (before they grow quite stunted) to some new plantation, and being cut down like quick-set will go near to thrive well.

I should also recommend the sowing of all mast when nature directs you, (acorns especially in *October*) that is, so soon as it is ripe, for the acorns which I sowed in that season did very well; and those for the most part failed which I reserved till *February*, the month directed for sowing them; the reason whereof I suppose to be, that *October* being a month for sowing hard-corn

hard-corn or winter-corn, and the mice, rooks, &c. being then busy in storing themselves with corn either yet left scattered or new sown, will not be so greedy after the acorns; whereas those reserved till *February* will spire by that time, do what you can, so must be sown; and that month being too early for the spring seed-time of corn, the rooks and mice, &c. especially the rooks, are so pinched for want of other food, that they will dig over all the ground new sown with the acorns, and destroy great part of them; and yet not meddle with those sown in *October*, the new breaking of the ground being the natural direction for them where to seek their food (a).

I am, SIR, Your unknown humble Servant,

H. GOODRICKE.

To

(a) The manner of sowing acorns, if designed for a small plantation, or to be removed, is to prepare some beds of fresh earth neither too strong and heavy, nor too light and dry. In these beds you should place the acorns in rows one foot asunder, and about two inches distance in the rows, covering them about two inches thick with the same fresh earth, observing to leave none of them uncovered, to entice the vermin, which may in a short time destroy all the seeds. In the spring, when the plants begin to appear, you must carefully clear them from weeds, and if the season proves dry, you should refresh them now and then with a little water. In these beds the plants should remain till the following autumn (observing constantly to keep them clear of weeds) at which time you should prepare a spot of good fresh earth, in size proportionable to the quantity of plants, which should be well trenched and levelled: then, towards the middle or latter end of *October*, you should carefully take up the plants so as not to injure their roots, and plant them out in rows three feet asunder, and eighteen inches distance plant from plant, observing never to suffer the plants to abide long out of the ground, because their roots would dry, and endanger the growth of the plants. When they are planted you should lay a little mulck upon the surface of the ground near their roots,

To follow the dictates of nature, in the putting of some seeds into the ground, is certainly the reasonable way, and undoubtedly may be a mean of preserving them

roots, to prevent the earth drying too fast; and if the season prove dry, you should give them a little water. When the plants have taken root in this nursery, they will require little more care than to keep them clear from weeds, and to dig the ground between the rows every spring; in doing which you should cut off such roots as extend very far from the trunk of the trees, which will render them better for transplanting again. You should also prune off such side branches as extend themselves very far, and would retard the upright shoot: but you should, by no means, cut off all the small lateral branches, some of which are absolutely necessary to be left on, to detain the sap for the augmentation of the trunk. When these trees have remained in the nursery three or four years, they will then be large enough to transplant to the places where they are to remain: for it is not proper to let them grow very large before they are planted out. The season for this work is in the autumn. When they are planted, the surface of the ground should be mulked about their roots to prevent its drying too fast. You should also stake them to prevent their being shaken and disturbed by the winds, which would retard their rooting. In transplanting these trees you should by no means cut off their heads; all that must be done is only to cut off any bruised or ill placed branches: but there can be no greater injury done to those trees than to shorten their shoots, which in that case often decay intirely, or at least down to the next vigorous bud. The trees thus raised and managed will, if planted in a proper soil, grow to a considerable magnitude, and are very proper for a wilderness in large gardens, or to plant in clumps in parks, &c. but if they are designed for timber, it is by much the better method, to sow the acorns in the places where they are to remain; in order to which, you should provide yourself in autumn with a sufficient quantity of acorns, which should be always taken from straight upright vigorous growing trees. These should be gathered from under the trees as soon as may be after they are fallen, and if possible in a dry time, laying them in some open room to dry; after which they may be put in dry sand and preserved in a dry place until the end of *November*, when you should prepare the ground for planting them. *Miller.*

them from the rooks or other voracious birds. But I think the surest way of preserving those which lie two years in the ground, would be to sow them with some corn or grain, which will pay more than the expence of the seminary five times over; and the corn is of so different a make and structure in its parts from the trees we sow with it, that it does not any way rob the ground of the nourishment which such trees will require: and I am fully persuaded, as well from what the above worthy gentleman relates concerning his nursery of oaks, as from the experience I have had since I received his curious letter, that grass and weeds rather contribute to the preservation of young seedling trees, than do them any harm; and therefore, as he justly observes, that expence of weeding is unnecessary, especially among those trees which are tap-rooted, as oaks, &c.

But let us now enter upon a few remarks and experiments relating to the improvement of some soils and grains, as they have been practised by several ingenious and learned men.

Dr Bury, of *Compton in Devonshire*, tells us in a letter, that the burning of the surface, which is so much practised in his country, is only used in bad lands, and by worse husbandmen; for, that it robs the ground, he tells us, is not only an observation of his, but also of others. If by bad lands these men understand the moory or heath-grounds, I cannot see what good can be done with the turf or peat (which is the heathy turf) unless it be burnt upon the ground: for though this is used for firing by some poor people, yet when there is any large quantity of such land turned up, there will be more turf or peat than can well be carried away. And again, as this turf chiefly consists of roots and other parts of vegetables, there must be in it many vegetable salts, which after it is burnt, will be fixt; though indeed we may say they are only the salts of such herbs and plants as we seek to destroy, and

and are not proper for the crop or grain they ought to nourish. But as we have observed before, that by solution, and exposing to the air, these alkaline salts will yield the marine salt; so the letting these ashes lie for a while exposed to the rain, snow and air, as experience shews, will bring them to that state, which Dr *Bury* in his letter esteems to be proper for the improvement of decayed or infertile land.

The doctor tells us, that salt quickens dead land, and is used in the south-west part of *Devonshire*, which would else be the barrenest, but is now the richest part of it: the people in that part of the country go for sand as far as the sea will permit at the lowest ebb, and do not grudge to carry it upon horses backs fourteen miles to spread on their land, and thereby improve it both for corn and grafs; in other parts of the same country they mend their barren land with lime.

He adds, that some suppose that crude and single salt, if strewed on the ground, instead of improving the ground, corrodes it: but that lime betters it; however in this they agree, that they produce not grafs fit for the scythe, but for pasture, being short and sweet, and growing all the winter. It is farther added, that by the coupling of these male and female salts, the ground would be much improved; nor would the highest ground be parched in the hottest summer: if the sea-salt is too lusty and active of itself, the lime has a more balsamic and gentle salt, which being directly joined with the other, is thereby invigorated.

Glauber gives us a lesson upon this occasion, not unworthy our notice: take, says he, quick-lime, and let it slack by time without water; then take salt and water, mix them together, and make them into balls, dry them as you do bricks, and burn them two hours; this compost, he tells us, will enrich the poorest land.

Doctor

Doctor *Bury* is so far persuaded of the good effect of salt and lime, that, in the conclusion of his letter, he wishes the duty were taken off sea-salt, that it might be more generally used for the improvement of land. And truly, I cannot help joining with him in his opinion; for as he observes, grass-grounds are much improved by common salt; and such things as abound with marine-salts, are greatly helpful to those lands which are designed for any of the gramineous or grassy tribe. It is a common practice in many places near the sea, to manure their grounds for corn with seaweeds, but they must be ploughed in pretty deep, and as soon (if possible) as they are brought upon the land.

CHAP. XIV. *An expeditious way of raising a coppice or close wilderness, with the method of embellishing it with wild flowers; as also some hints for rendering it still more rural, by raising of tame pheasants and partridges: in a letter to Mr R. S. of Surrey. To which is added, the method of improving land by the alder and abele-trees.*

SIR,

I Had the pleasure of your commands in relation to a coppice or close wilderness; and I find every one agreeing with you, that an invention for making such a plantation compleatly at once, would save time, and that it would be, in some sort, adding to the length of our lives.

I have been diligent in observing the plantations made in several nurseries, and have as industriously inquired the time of planting every parcel of trees growing in them, that I might, at least, let you know how long you must wait for the perfection of the plantation you design.

P

By

By the perfection of such a plantation, I mean, that it be planted compleatly, and that every plant be in such a vigorous way of growth, that we may look upon it rather as a natural than an artificial work. I have seen a plantation of this kind, which has been only four months planted, that has grown above four feet high; and the second year some of the plants have been above eight feet, which is high enough to give a pleasing prospect.

The accident which produced the tall and upright shooting of these plants, gives me an opportunity of prescribing for your design the same method of planting as was practised by Mr *Scott* the nursery-man: he transplanted a large parcel of young elm-plants out of the first bed in *March*, setting them in rows about six inches distant from one another, and the lines about a foot apart: by this means they were not subject to make too many collateral shoots, but were all inclined to rise and meet the air above; so that these upright shoots had not only their own natural share of nourishment, but likewise enjoyed all that should have gone to the subsistence of the collateral branches. In short, this method of planting answered the end you seem to desire, better than any I have seen; that is, it grew up, in about eighteen months time, to such an height, and was so fully furnished, as a plantation in the ordinary way would not have done in less than four or five years time.

Therefore I would advise, that you plant your wilderness after this manner with young plants, which must be cut pretty near the ground at planting; and in two years or less, you may begin to draw out near half the plants to be placed elsewhere in your grounds; this will encourage the growth of those that are left standing, by giving them the necessary air, and opening the earth about their roots.

Nor will the charge of making this plantation be more than if you was to plant large trees at due distances;

tances; the small plants, though they will be perhaps eight times more numerous, yet their price will be in proportion to their bigness; they will thrive with more certainty than the large plants, and will fill your coppice much better, and, as was observed before, much more quickly: besides, by their being planted so young, they will more easily be naturalized to the soil, and will prosper three times as well as others that had been many years growing elsewhere.

I remember once a gentleman of my acquaintance planted a thicket of young plants in the manner I recommend, and the same year planted a grove of trees about nine years old; his thicket in less than four years grew taller than his grove, and had much handsomer plants in it, although the oldest of his thicket-plants were not above two years old when they were set in his wilderness. So that six years growth in the way of planting which I propose, gives better plants than thirteen years, where trees are planted in groves in the common way; which is, in effect, gaining seven years time compleatly, while we are passing six years (a).

P 2

In

(a) In the first raising of coppices from seed, the ground must be prepared by good tillage, as much as if it were intended for corn. The seeds of the several trees are to be sown in *February*, and if the soil be shallow, the ground should be ploughed into great ridges: this will make the soil lie the thicker upon the top of each ridge, by which means the roots will have more depth to run to for nourishment, and in a few years the furrows will be filled up to the level of the rest with the dead leaves; and these, as they rot at the bottom, will make a kind of a soil, through which the young roots will spread, and be conducted from one ridge to another, and so the whole ground will be occupied by them. If the coppice is to be raised on the side of a hill, plough the ridges cross the descent of the hill, that the water may be detained among them, and not suffered to run off, as it otherwise would, by the furrows; but if it happen that the ground be over-wet, which

In such coppices I think no plant is more agreeable than the filbert and *Spanish-hazle*, which last may be set in nuts about *October*; for I find no nurseries that are furnished with them, though I have experienced that they grow very well.

Neither is it necessary to plant this coppice according to any plan or figure; the walks may be cut when it is grown up, and their edges bordered with cowslips, primroses, violets, and other wild flowers, to make it appear more rural; and if there should be enclosed with it two or three acres of ground, to be sown with furze or broom, for harbour or shelter for pheasants and partridges, it would be yet more pleasant.

We have instances enough of pheasants, though they have the liberty of the wing, so tame that they will every night return to their own home; and as often as they are called by their keepers, will come to them: they will breed without any trouble in such a place as I have mentioned, but the young ones should be caught at a month old, and fed; they will then

which is more rarely the case, then the contrary method is to be observed, and the furrows are to be ploughed deep and straight downwards, that all the water may be carried off by them, as by so many trenches or drains. Some sow a crop of corn along with the seeds of the under-wood, for the advantage of the first year; but as the season of sowing the seeds of the trees, is too late for the sowing the corn, it seldom turns to much advantage. It is better to sow the trees alone, and keep them well weeded the two first years; after which they are strong enough to take care of themselves against such enemies. In very barren ground, where the young trees can hardly stand the heat in summer, it is proper, after sowing them, to scatter a quantity of furze-seed over the land; the furze will grow quick, and over-top the trees at first, but it will serve as a guard to them at this time, defending them from injuries, and keeping the ground moist about their roots. In a few years the trees will grow beyond these bushes, and they will then soon destroy them by their dropping.

Mortimer.

then live upon corn alone, and may be easily tamed and disciplined.

Nor are partridges more difficult in their management; I have taken them at two months old, and made them so tame and familiar, that they have followed me every where, as well about the house as without doors; and some of them would frequently fly upon the table when I have been at dinner, regardless of all fear. This is what I shall at present communicate to you; and am, SIR, Yours, &c.
R. BRADLEY.

A letter to a gentleman concerning the improvement of an acre of low wet ground, by alder or abele-trees.

SIR,

Your desire of my advice, in regard to what you must do with that piece of ground, which you observe lies wet, gives me an opportunity of recommending two ways to you of improving it. The first is by planting of alders, to be cut once in three years for poles, or to make a speedy shelter; or else to bear with it some time, whereby you may at once get a valuable sum of money from it.

If you chuse the first, that is, to reap a crop every third year, you must plant your ground with truncheons, or sets of alder, in the spring, about thirty-six in a rod of ground; then upon an acre you will have five thousand seven hundred and sixty plants; and if they take with the ground, which they will do if it is often overflowed, then in three years the lop, or their produce in branches, at five shillings *per* hundred upon the spot, will amount to the value of about fifteen pounds. So that you have five pounds *per annum* for your acre. Now the price I have set is much lower than they will sell for, and every truncheon will bring three or four branches the first year, which is abundantly more than I have rated them at, and the second cutting will give you nine or ten from every
P 3 plant;

plant; so that one may reasonably put this plantation at ten pounds *per annum*, one year with another; and then in twenty years the profit would be two hundred pounds, and part of the money paid every third year to be employed to profit.

On the other hand, if the ground is not subject to be overflowed often, you may plant in it about an hundred and sixty abeles, which, if you allow them twenty years growth, will be worth about one hundred and sixty pounds. Now the plantation of alders, in my opinion, is like enjoying an estate at present; and the abeles is like having an estate in reversion. The price of the plants will be about the same value, but the alders will cost more to plant them than the abeles; they will both be profitable, and it is in your own choice whether the one or the other.

I am, SIR, Yours, &c.

R. BRADLEY.

CHAP. XV. *Considerations upon Captain Cumberland's invention for softening and making timber pliable, as it is practised in his majesty's yards for ship-building, whereby the most rude and crooked timber may be made straight, or planks of any thickness may be brought to the bow.*

WHAT I have already mentioned in this piece, relating to the planting and improving of timber, seems to command the following observations concerning the use of it.

Having lately, in a particular manner, taken a tour about several of the royal docks for building of ships, as well as some more private ones, I had the curiosity to observe the ingenious contrivance of captain *Cumberland*, for bending of plank and timber by sand-

sand-heats, which he has now brought to so great a perfection, that even pieces of ten inches length, by two feet broad, may be brought to any bow in such a manner as to preserve all its primitive strength; and also crooked and surly sticks of timber, of far greater bigness, may be made straight by the same means.

I believe it is pretty well known, that the methods which have been used to bring planks for shipping, &c. to the bow, has been done by burning, before the captain's invention took place: that method of bending plank, by burning, was not only brought about by expensive firing, but by an expensive attendance; and then, when all was done, the strength of such planks was greatly impoverished, for by such a burning many of the binding vessels of the wood were broken, and rendered unfit for any use. Again, I observed, that large scantlings of timber could not be brought to bend by burning, so that the workmen in such cases were forced to have recourse to compass-timber, or to cutting out a bow, or an arch, from a solid piece of timber, at more than double the expence it would have been, if they could have bent the solid piece to their bow, of which the following example is a proof.

One piece of compass-timber, containing one hundred feet, makes but one harpin of ten inches thick for a first rate man of war; but by captain *Cumberland's* method, a piece of straight timber, containing only ninety-five feet, made two harpins of the like substance, and one piece of five inches thick for such a ship; which difference is very considerable, if we reflect that the hundred feet compass-timber, *i. e.* two load, worth three pounds ten shillings *per* load, is seven pounds for one harpin; and that by the captain's method we have two harpins of the like sort, besides a piece of five inches, for five pounds fifteen shillings; or ninety-five feet, after the rate of three pounds *per* load.

The bending of timber by the captain's method of sand-heats, has yet this advantage in it, that it seasons the timber, by exhaling or drawing from it all the watery or aqueous parts, as is evident from the sand's being discoloured when the timbers are come to a right bending state: and these watery parts, every one knows, are the first occasion, as well of the rotting as of the shrinking of the timber; which last is in a particular manner so well understood, that every one seeks for well-seasoned timber, and is content to pay considerably more for it, as it prevents a second trouble in building, by rejoining of parts, which in unseasoned planks or boards are apt to fly asunder. Nor is this all the good we are to expect from well-seasoned timber, planks, or boards; for, besides the exhaling of the watery parts, we preserve the resinous or gum-like juices in the wood pure and unmixed, which tend to preserve the wood and prevent rottenness (a).

One

(a) Seasoning of timber is a term used by our husbandmen, to express the preparing timber after it is felled, for cutting and working up for use. As soon as felled, it should be laid up in some dry airy place, but out of the reach of too much wind or sun, which, when in excess, will subject it to crack and fly. It is not to be set upright but laid along, one tree upon another, only with some short blocks between, to give it the better airing, and prevent its becoming mouldy, which will rot the surface, and produce mushrooms on it. Some persons daub the trees all over with cow-dung, which occasions their drying equally, and prevents their cracking, as they are otherwise very apt to do. Some recommend the burying timber in the earth, as the best of all ways of seasoning it; and others have found it a fine preservative to bury their timber under the wheat in their granaries; but this cannot be made a general practice. In *Norway*, they season their deal planks, by laying them in salt-water for three or four days, when new sawed, and then drying them in the sun; this is found a great advantage to them; but neither this, nor any thing else, can prevent their shrinking. The seasoning timber

THE CONSTITUTION OF THE UNITED STATES

Article I
Section 1
All legislative Powers herein granted shall be vested in a Congress of the United States, which shall consist of a Senate and House of Representatives.

Section 2
The House of Representatives shall be composed of Members chosen every second Year by the People of the several States, and the Electors in each State shall have the Qualifications requisite for Electors of the most numerous Branch of the State Legislature.

Section 3
The Senate of the United States shall be composed of two Senators from each State, chosen by the Legislature thereof, for six Years; and each Senator shall have the Qualifications requisite for Senators of the most numerous Branch of the State Legislature.



One thing which pleased me extremely in this way, was the straightening of a piece of timber fifty feet long, which squared at the butt about two feet, and at the top about eighteen inches. It is represented by *Fig. I. Plate V.* but notwithstanding its crooked form, and its extraordinary contents, when it was sawed through lengthways, and had been put in the sand-heat, being then placed upon a flat piece of timber, and braced down with ropes, it was afterwards brought with wedges to be perfectly straight. This method, I think, will be of great use, considering how much uneven timber we have in *England*, and how much

timber by fire is the best way of all, for piles and other pieces that are to stand under the earth, or water. The *Venetians* first found out this method, and the way they do it is this; they put the piece to be seasoned into a strong and violent flame, in this they continually turn it round by means of an engine, and take it out when it is every where covered with a black coaly crust; by this means the internal part of the wood is so hardened, that neither earth nor water can damage it for a long time afterwards. This method is practised in many places for seasoning the posts for paling of parks, &c. and has this to recommend it, that in the very oldest ruins we have ever been acquainted with, there have been found many times pieces of charcoal, all of which have been found uninjured, though buried in the earth for ever so many ages. When timber has been properly felled, and seasoned, by being exposed to a certain degree of air and sun, there is yet a method of preserving it, much better than it could otherwise be, by external applications. When the pieces are wrought and fixed in their places, the rubbing them over with tar or linseed-oil, has been found of great use. The antients, particularly *Virgil* and *Hesiod*, advise the smoak-drying of all instruments made of wood, by hanging them up in the chimnies where wood-fires are used. The whole benefit arising from this, seems to be the oil of the wood that is burnt, entering into the pores of the other as carried up in the smoak. But it would be a much more cleanly and easy method to apply some oil of this kind at once, and in any quantity that should be judged requisite. *Mortimer.*

much has been cut and lost for want of such an invention.

Since I have observed these things, I cannot help taking notice, by the by, that this way would be of extraordinary use in building of cupolas, and every thing where compass-work is required, and even in the making of wheels; which last might have the part called the nave made of two pieces only; this bended timber carrying a great deal more in strength in it than any that is cut out of solid pieces; besides that what may be saved by this means, will be very considerable.

But that we may have a better idea of what relates to the superior strength of the bended timber, we may observe the following particulars.

First, that all timber is composed of two sorts of vessels, *viz.* those which run lengthways through the body of it, and others which are interwoven among them, of a more tender nature, that run cross-ways. The first are like those strings which remain in flax or hemp after it is dressed, wherein is the strength of the plant; the other is composed of those vessels which are beaten off when the hemp or flax is pounded; and these two sorts of vessels are found in all plants whatever: so that the first sort of vessels, *viz.* the long ones, are to be preserved as much as possible for the strength of timber. *Plate ib. Fig. II.* shews, by many straight lines running from A to B, the long vessels which I speak of; and which, as long as they remain entire and together, are like the bundle of rods in the fable, not to be broken; but let any one judge, (when many of these strings are cut, as appears by the compass-work marked out between A and B) whether the arch to be cut out of such a piece of wood, would not be very weak, in comparison of a piece of wood bent as I have mentioned, or as we may observe in *Fig. III.* where we may see these vessels

vessels of strength reaching quite through the piece which is bent to an arch; surely then such an arch, when it does perish, must decay all at once, because all parts are alike in strength; and considering how much the lives of great numbers of men depend upon the strength of those ships they go to sea in, the strongest way of building ships is to be preferred. But there are two objections to this manner of bending timber; the first is, that it will not always stand bent to the bow we first bring it to: however we see no reason for this objection, because that we find large pieces of such bent timber which being only confined till they turned cold, have then had their braces taken off, and continued as perfectly bent, as they were when braced, without the least guard to keep them from flying out: the reason is, because, as was observed before, there remains only the resinous juices in the timber, after it is heated to the purpose: then those juices, which harden extremely when the wood comes to be cold, cannot give way again, until they are melted, or made fluid, by an heat equal to that which disposed the timber first to be bent. This is just as if we were to dip a piece of rope in melted rosin, which will bend while the rosin is warm, but when once it is thoroughly cold, it becomes stiff and hard, and cannot be resolved into its first capacity of easy bending, until the rosin is again warmed, and becomes fluid.

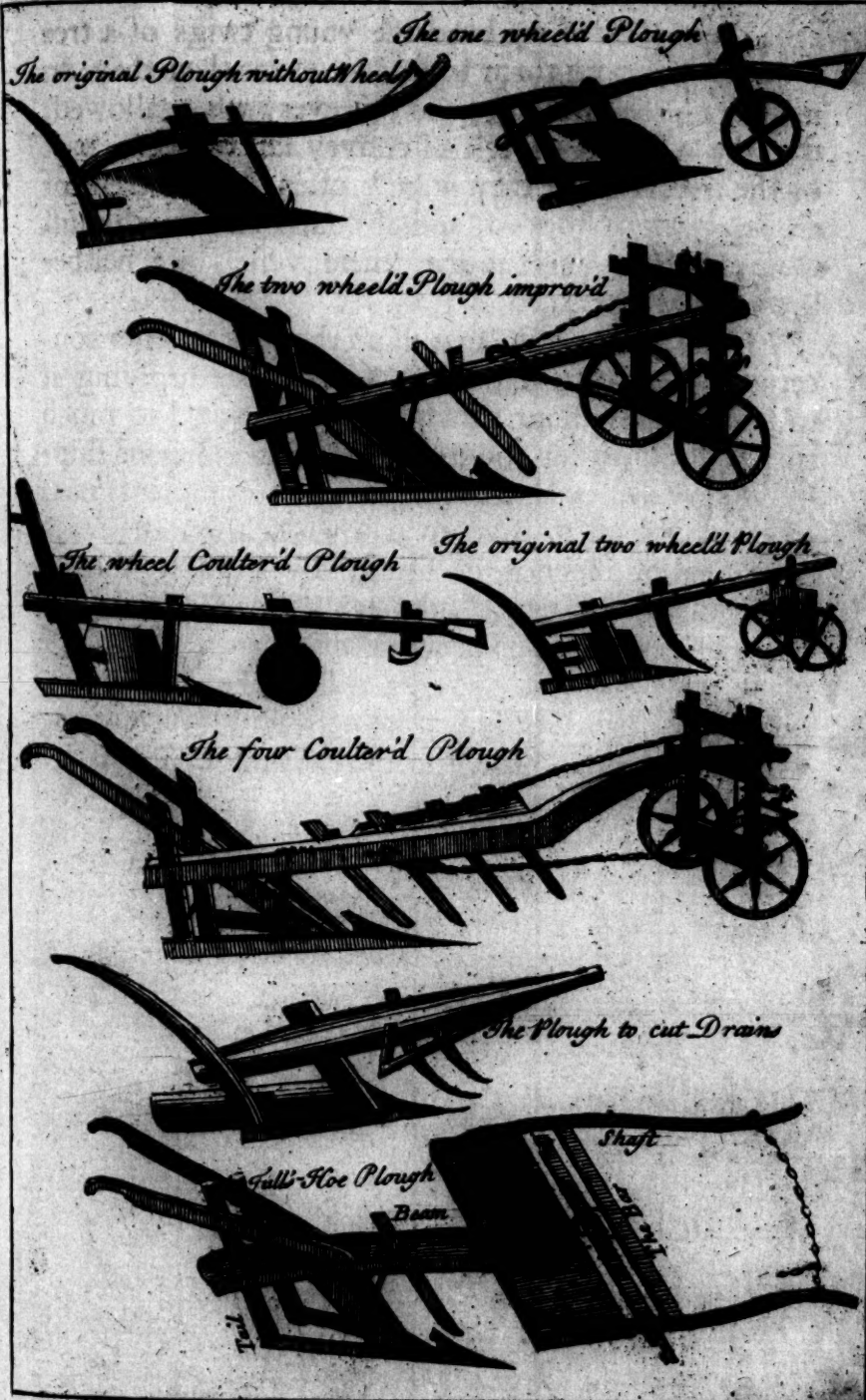
The second objection is, that by bending of timber, these vessels, which I say support the strength of it, are some strained and some broken, and that there are none of them left in the strength they had before. If it were so, how comes it about that in laying down branches of trees in the ground in order to take root, which must bend them much more than the method I have mentioned, that these branches grow in all their parts as well as they did before we bent

bent them? Or if we bend the young twigs of a tree so much as to tie them in knots, even then they do not refrain their growth; and it is every where allowed, that the vessels we speak of convey sap to every part of the tree, and if they were broken, the current of the sap must be stopped, and of course all growth must cease; so it is evident that these vessels are neither broken nor weakened.

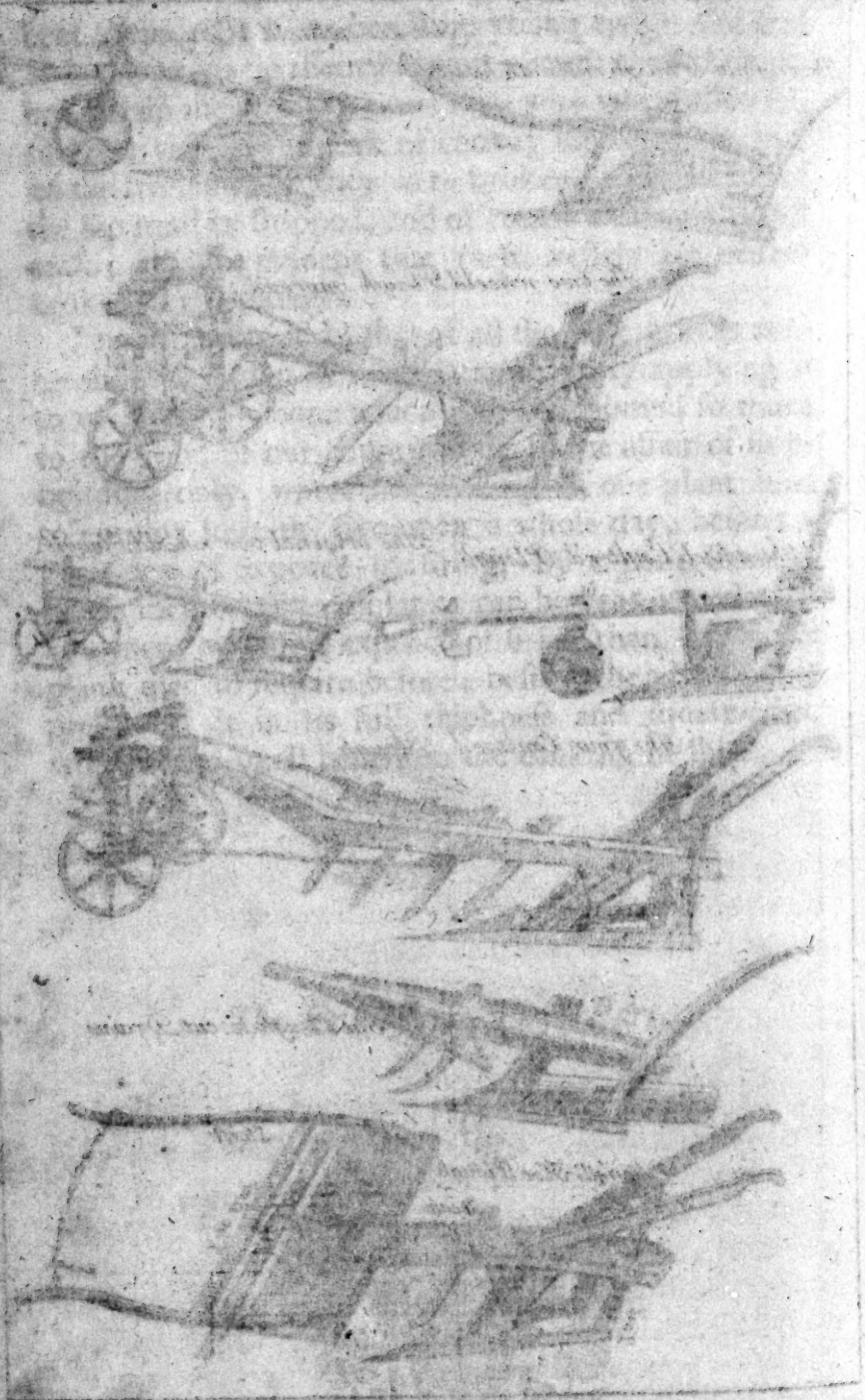
I have only to add, that of all the experiments concerning the saving of timber, and rightly applying it to use, I know none which ever contributed so much to the good of our country; for in the affair of ship-building only, where the bending of one plank used to employ four or five men a whole day, besides a great deal of expence in firing, by captain *Cumberland's* method sixteen planks can be bent in a day by two men, with less expence of firing than one single plank used to require before; besides the advantage of preserving it in its full thickness and square-edge, which is no small benefit in the cauking of ships.

The End of the First Part.





A View of the several PLOUGHS in use throughout England



View of the car from the front

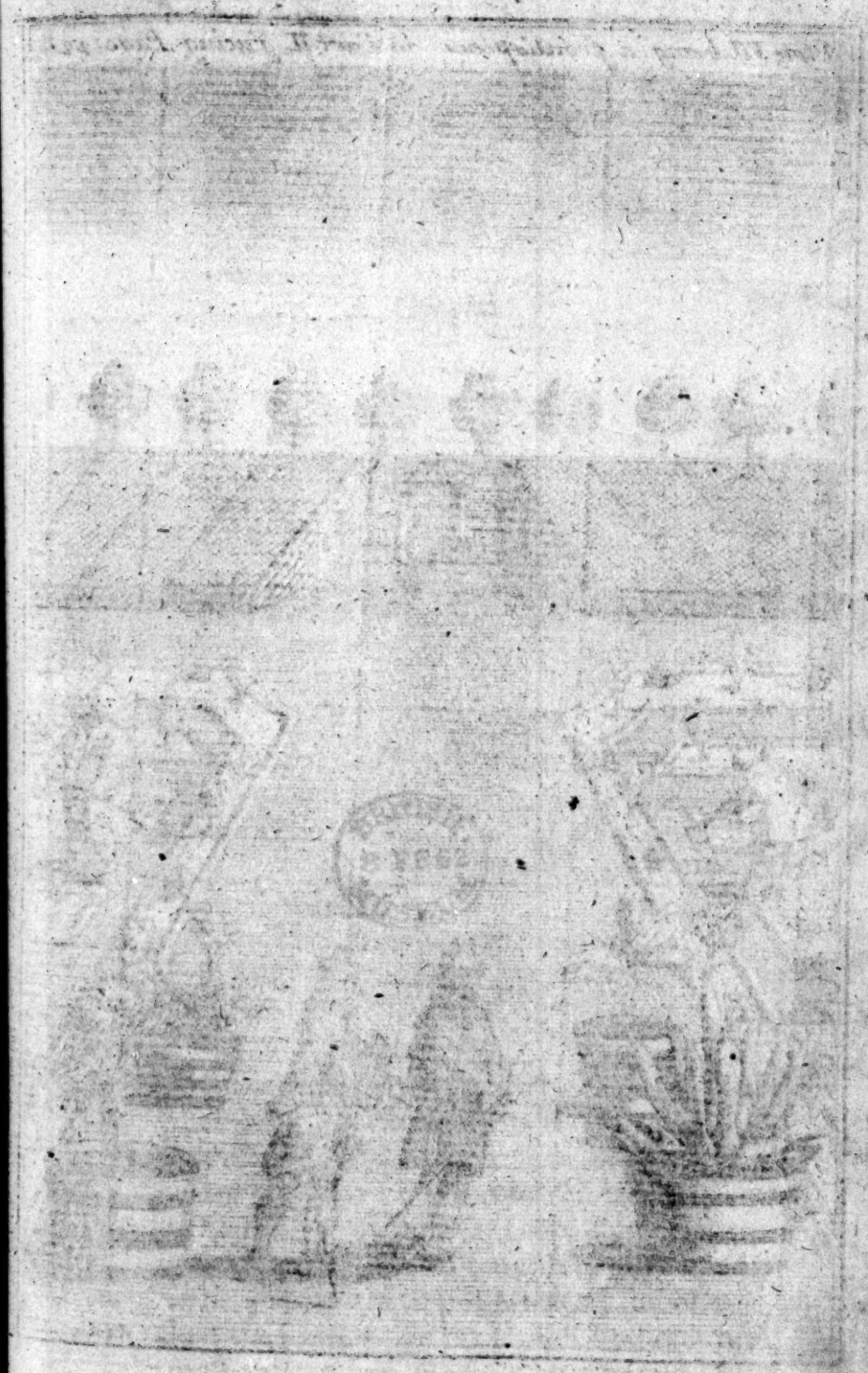
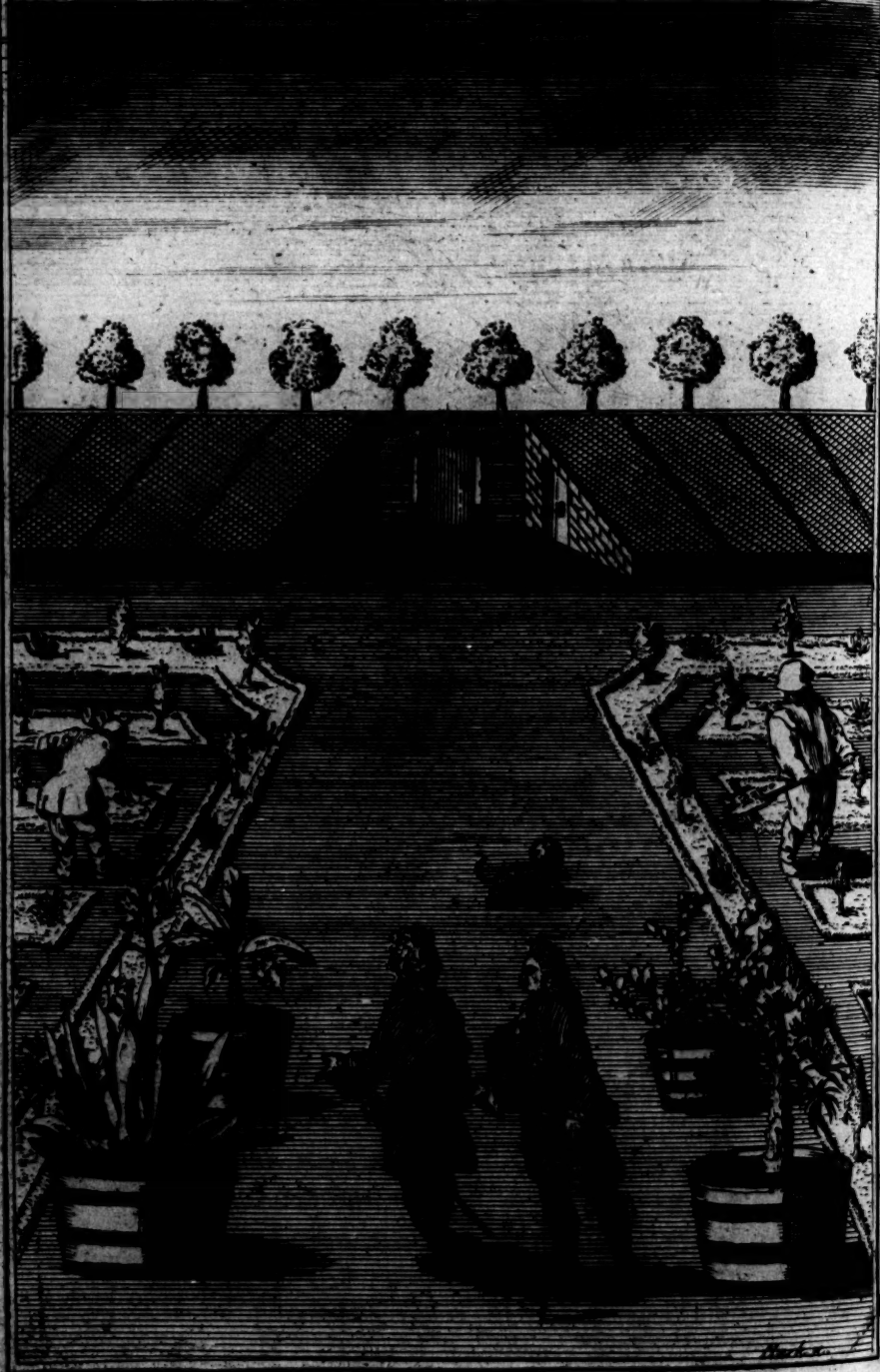


Plate III being a frontispiece to Part II facing Page 221



A General

TREATISE OF AGRICULTURE.

PART II. Of GARDENING.

INTRODUCTION.

AS it is the opinion of some people, that the bare publishing of experiments in husbandry and gardening, can be but of little use to public, unless they are cultivated and promoted by ingenious and skilful men; I shall therefore take this opportunity of laying before the world some rules for the education of those who design to profess that kind of agriculture called the hortulan art; that those studies, which are of the most antient date, may not only be cultivated with new vigour, but that the practitioners, as well as the

the theorists, may go hand in hand in the improvement of our lands.

That I may therefore improve, as much as possible, an art which is so useful and beneficial to mankind, I am the more solicitous to cultivate that kind of learning in a philosophical way; that in time it may be further improved, and that the curious may find more judicious operations among the practitioners in agriculture, and a conversation becoming the quality of that unbounded study.

1. In order to this. I shall first propose, that only such as have a natural bent of genius to this study should ever be brought up to so ingenious a profession.

2. That where such a person is found, he should be instructed in the *Latin* tongue, writing, arithmetic, mathematics, and designing.

3. That he should, in the unbusied times of his practice, acquaint himself with the rules and terms of botany, so far as they may relate to the classing or sorting of plants to their respective tribes or families; or to the numbering them according to their genders; the following examples of which I take from the great Mr Ray.

Gender 1. The imperfect plants, are those which do either totally want both flower and seed, or else seem to do so, there having yet no seed or flower been discovered to belong to them; such as corals, sponges, *algæ conservæ*, duck-meat, or *lens palustris*, the fungi, or mushrooms, *tubera terræ*, or truffle, the mosses, and some liverworts.

Gender 2. Plants producing either no flower at all, or one seemingly imperfect, and whose seed is so small, as not to be discernable by the naked eye: some of these bring their seeds on the back parts of their leaves, as the maiden-hairs, spleenworts, *polypodium* and ferns; others bear it on the stalk itself, adhering there by small single foot-stalks, as the lichen-

lichen-terrestris, the lycopodium, or wolfs-claw, the golden maiden-hair, the moon-wort, horse-tail, &c.

Gender 3. Those whose seeds are not so small as singly to be invifible, but yet have an imperfect or flaminous flower; *i. e.* fuch a one as is without the flower-leaves, having only the flamina, and the perianthium; as hops, hemp, mercurialis, nettles, docks, forrels, arlesmart, knot-grafs, pond-weed, oracle, blite, beet, lady's mantle, &c.

Gender 4. Such as have a compound flower, and emit a kind of white juice or milk when their stalks are broken; fuch as lettuce, fow-thistle, hawkweed, dandelion, fuccory, goat's beard, nippleworts, &c.

Gender 5. Those which have a compound flower of a difcous figure, the feed pappose, or winged with down, but emit no milk like the former; as colt's foot, flea-bane, golden-rod, rag-weed, groundfel, cud-weed, &c.

Gender 6. The capitated herbs, or fuch whose flower is composed of many fmall, long, hollow flowers, gathered together in a round button, ball, or head, which is ufually covered with a fcaly coat; of which kind are the thistle, the greater burdock, blue-bottle, knapweed, faw-worth, &c.

These have all down adhering to their feeds.

Gender 7. The corymbiferous-plants, which have a compound difcous flower, but their feeds no down adhering to them: the name is taken from the manner of bearing its flower in clufters, and fpreading round in form of an umbrella, as onions, &c. of this kind is corn-marigold, common ox-eye, yarrow, the dafie, camomile, tansie, mugwort, fcabious, teasel, cryngos, &c.

Gender 8. Plants with a perfect flower, and having only one fingle feed belonging to each fingle flower; fuch as valerian, corn-fallet, agrimony, burnet, meadow-rue, fumitory, &c.

Gender

Gender 9. The umbelliferous plants, which have a pentapetalous flower (*i. e.* having just five small petals or flower-leaves) belonging to each single flower; in these there are two seeds lying naked and joined together. They are called umbelliferous, because the plant, with its branches and flowers, hath an head like a lady's umbrella, the *Latin* whereof is *umbella*.

This is a very large genus of plants, which therefore is subdivided into classes.

Class 1. Such as have a broad flat seed, almost of the figure of a leaf, or which are encompassed round about with something like leaves; as cow-parsnep, wild and garden-parsnep, hog's fennel, &c.

Class 2. Such as have oblong seed, swelling in the middle, and larger than the former; as shepherd's needle, cow-weed, wild chervil, common Spignel or meum, &c.

Class 3. Such as have a shorter seed; as angelica and alexanders.

Class 4. Such as have a tuberous root; as the earth-nut, kipper-nut or pig-nut, water-dropwort, &c.

Class 5. Such as have a small wrinkled, or striated seed; as stone-parsley, water-parsnep, burnch, saxifrage, caraway, smallage, hemlock, meadow-saxifrage, samphire, fennel, rock-parsley, &c.

Class 6. Such as have a rough, hairy, or bristly seed; as mountain, stone-parsley, wild-carrot, hedge and bastard-parsley, chervil, sea-parsnep.

Class 7. Such as have their leaves entire, and not divided into jaggs, &c. as thorow-wax, sanicle, the least hare's ear, &c.

Gender 10. The stellated-plants, so called because their leaves grow on the stalk, at certain distances, in form of a star. Their flowers are monopetalous, but divided in four segments, which look like so many distinct flower-leaves; and each flower brings two seeds, which grow at the bottom of it. Of this kind

is,

is crowsfoot or mugweed, madder, lady's bedstraw, woodruff, cleavers, &c.

Gender 11. The *plantæ asperifoliæ*, or rough-leaved plants, are such as have their leaves placed alternately, or without certain order, on their stalks; they have a monopetalous flower cut or divided into five segments; and after every flower there succeed commonly four seeds. Of this kind are hound's tongue, wild bugloss, viper's bugloss, comfrey, mouse-ear, scorpion-grass, &c.

Gender 12. The verticillated-plants, says Mr Ray in his *Synopsis Methodica Stirp. Britann.* have the following certain marks, or characteristic notes, viz. their leaves grow by pairs on their stalks, one leaf right against another; their flower is monopetalous, and usually in the form of an helmet or hood; each flower brings four seeds usually, which have no other seed-vessel but the perianthium; for that mark of their flowers, growing in whirls about the stalks, as they do in the dead-nettle, hore-hound, &c. is not found in all plants of this genus. To these belong mother of thyme, mint, penny-royal, vervain, woodbetony, self-heal, ale-hoof, bugle, scordium, motherwort, &c.

Gender 13. Such as have many naked seeds (at least more than four) following their flower, are called, *polyspermæ plantæ semine nudo*. By the words *semine nudo*, or with naked seeds, botanists mean such as are not included in any seed-pod, capsule or case, out of which they readily drop; as also such as either have no covering for their seeds, or else drop off with their covering upon them. Of this kind are pilewort, crowfoot, marsh-mallows, avens, strawberries, cinquefoil, tormentil, meadow-sweet, &c.

Gender 14. Bacciferous-plants, are such as bear berries; as bryony, dwarf-honeysuckle, butcher's broom, solomon's seal, lilly of the valley, night-shade, asparagus, whorts or whorle berries, &c.

Q

Gender

Gender 15. Multifiliqueous, or corniculated plants, are such as have, after each flower, many distinct, long, slender, and many times crooked pods or filiquae, in which their seed is contained, and which, when they ripen, open of themselves, and let the seeds drop out: of this kind are the common house-leek, orpine, navel-wort, or wall-penny-wort, bear's foot, marsh-marigold, columbine, &c.

Gender 16. Such as have a monopetalous flower, either uniform or difform, and after each flower a peculiar vessel or seed-case (besides the common calyx) containing the seed, and this often divided or parted into many distinct cells. These are sometimes called vasculiferous plants; such as common henbane, marsh-mallow, bindweed, throat-wort, rampion, toad-flax, fox-glove, red-rattle, or cock's-comb, eye-bright, &c.

Gender 17. Such as have an uniform tetrapetalous flower, but bring their seeds in oblong filiqueous cases; as stock-gillflowers, wall-flowers, common whitloegs, jack by the hedge, or sauce alone, mustard, charlock, or wild mustard, radish, wild rocket, lady's smock, scurvy-grass, woad, &c.

Gender 18. These are vasculiferous plants, with a seeming tetrapetalous flower, but of an anomalous, or uncertain kind; for this flower, though it be divided in four segments, is nevertheless monopetalous, and falls off all in one; such as speedwell or fluellin, wild poppy, yellow-poppy, loose-strife, spurge, and plantain.

Gender 19. Leguminous plants, are such as bear pulse, with a papilionaceous flower. Their flower is difform, and almost in the shape of a butterfly with the wings expanded, (whence it has the name papilionaceous) consisting of four parts joined together at the edges; such as pease, vetches, tares, lentils, beans, liquorice, bird's foot, trefoil, rest-harrow, &c.

Gender 20. Vasculiferous plants, with a pentapetalous flower, like the sixteenth or eighteenth kind, have,

have, besides the common calyx or cup of the flower, a peculiar case containing the seed, each flower consisting of five leaves or petals; such as maiden-pink, campion, St John's wort, male pimpernel, chick-weed, crane-bill, flax, primrose, periwinkle, centaury, wood-sorrel, marsh-trefoil, &c.

Gender 21. Plants with a true bulbous root, which root consists of but one round ball or head, out of whose lower part or basis there shoot out many fibres or strings to keep it firm in the earth. The plants of this kind, when they first appear, come up with but one leaf, and the leaves are nearly approaching to those of the grass kind; for they have no foot-stalks, and are long and slender. The seed-vessels are divided into three partitions; and their flower is usually hexapetalous, or seemingly divided into six leaves or segments; such as garlick, daffodil, hyacinth, saffron, &c.

Gender 22. Such as have their roots almost like bulbs: these emit at first coming up but one leaf, and in their leaves and flowers have some resemblance of the true bulbous plants; such as flower-de-lis, cuckoo-pint, orchis, broom, rape, bastard-hellebore, tway-blades, winter-green, &c.

Gender 23. Culmiferous plants, with a grassy leaf and an imperfect flower, are such as have a smooth hollow-jointed stalk like straw, with one long sharp-pointed leaf at each joint, encompassing the stalk, and set on without any foot-stalk: their seed is contained within a chaffy husk; such as wheat, barley, rye, oats, and most kind of grasses; the straw of the wheat and barley has four knots each, from the root to the ear.

Gender 24. Plants with a grassy leaf, but not culmiferous, with an imperfect or staminous flower, as cypress grasses and rushes, cat's tail, bur-reed, &c.

Gender 25. Plants whose place of growth is uncertain and various: but are chiefly water-plants; as the

water-lilly, water-mill-foil, water-wort, pepper-grass, mouse-tail, milk-wort, dodder, &c. (a).

There

(a) *Linnaeus* has lately established an entirely new system, founded on the number and different structure observable in the male and female parts of generation in each plant; the former of which is called stamen, or stamina when there are more than one of them, and the latter pistil. From the number and situation of the stamina he has arranged the whole family of plants under twenty-four classes, viz.

1. The monandria, or that class only with one stamen or male part in each flower; as the canna, boerhaavia, &c.

2. The diandria, or that class with hermaphrodite-flowers that has only two stamina in each; as sage, olive, phillerea, jessamine, rosemary, &c.

3. The triandria, or that class with hermaphrodite-flowers that has three stamina in each; as the tamarind, valerian, saffron, iris, &c.

4. The tetrandria, or that class with hermaphrodite-flowers that has four stamina in each; as the dipsacus, scabiosa, &c. and so in like manner of the six succeeding classes, all denominated from the number of their stamina, viz. 5. The pentandria. 6. The hexandria. 7. The heptandria. 8. The octandria. 9. The enneandria. And 10. The decandria.

11. The dodecandria class has twelve stamina in each hermaphrodite-flower; such are agrimony, asarum, &c.

12. The icosandria class of plants has about twenty stamina inserted either into the side of the calyx or corolla; though here the term icosandria is taken in a lax and indeterminate sense, so as to comprehend all plants with more than twelve stamina, and for the most part not much exceeding twenty: however, the characteristic of this class is rather to be taken from the manner of insertion, than number of the stamina: to this class belong the torch-thistle, the amygdalus or almond-tree, the cherry-tree, &c.

13. The polyandria consists of a large number of stamina in each hermaphrodite-flower: these always exceed the number of twelve, and grow on the receptacle of the future seeds; of this class are the water-lilly, poppy, celandine, &c.

14. The didynamia class of plants consists of four subulated stamina inserted into the tube of the flower, two whereof are shorter than the other, and placed together; the antheræ being

There is also another common division of plants, into trees, shrubs, under-shrubs and herbs, which I shall mention in some other papers, for the sake of those

being commonly hid under the upper lip of the flower and connivent in pairs. It has its name from the two longer stamina, being supposed more efficacious in fecundating the seeds than the rest. To this genus belong baum, germander, lavender, thyme, betony, mint, fox-glove, bear's breech, &c.

15. The tetradynamia class of plants has six stamina in each flower: these stamina are subulated, erect filaments, four of which being of more efficacy than the rest are longer, but however not so long as the petals: this class is the cruciformes of *Tournefort*, and the siliquosæ, or siliculosæ, or seventeenth class, of *Ray*, consisting of the scurvy-grass, mustard, &c.

16. The monadelphia, a class thus called because the stamina of the flowers are so interwoven as to form one body; or rather because the stamina are connected, or coalesce at the base: to this class belong the mallow, alcea, althæa, and hibiscus.

17. The diadelphia class, comprehending all those with papilionaceous and hermaphrodite-flowers, and leguminous seed-vessels. The distinguishing characteristic of this class is, that the stamina adhere together, forming two dissimilar bodies, or filaments, the one standing above the pistil, the other surrounding it: this class comprehends the beans, pease, vetches, liquorice, and several other genera.

18. The polyadelphia has the stamina connected together at their bases into several serieses; and the plants of this class are subdivided into orders according to the number of their stamina: thus the polyadelphia-pentandria contain five stamina, and the polyadelphia-icosandria and polyandria contain twenty or more stamina.

19. The syngenesia is so called because the stamina in the plants of this class grow together, or are formed into a single, regular congeries: these stamina are five very short and slender filaments inserted into the tube of the flower.

20. The gynandria comprehends all those plants whose stamina are placed either on the style, or on the receptacle elongated into the form of a style, and carrying on it both the pistil and the stamina. Of the several genera of this class some have two stamina to each flower; some again have

those who have not had education enough to read the original works of the botanical authors with ease and pleasure. In the mean time, for the more easy understanding

three; and others four, five, six, ten, or more; and hence they are naturally arranged into several distinct orders, under the appellations of gynandria-diandria, gynandria-triandria, &c.

21. The monoecia class has the male and female flowers placed separately on the same plant, or rather on different stems growing from the same root. Of the plants belonging to this class some have only one stamen, others have from one to six, or more stamens, whence the subordinate orders of monoecia-monandria, monoecia-triandria, &c. others again are monadelphous, others syngenesious, and others gynandrous.

22. The dioecia class comprehends all those plants which have the male and female parts of fructification, or the stamens and pistil, on distinct plants of the same kind, in which respect they are thought to bear some analogy to quadrupeds, whose males and females are likewise distinct: to this class belong the willow, hemp, poplar, juniper, yew, &c. in all which the female plants alone bear seeds: but these prove barren, unless planted near the male plants, so as to be within the reach of their farina fecundans, according to *Linnaeus* and the sexualists, who have established the classes of plants upon the differences of the sexes and parts of fructification: however the truth of this position is much contested; and several, from actual experiments, pretend to have proved that the influence of the dust of the apices is not absolutely necessary to the fecundity of the seeds: the botanical reader, who would be further informed in this famous controversy, and the result of several experiments made to determine it, we refer to the learned and ingenious Dr *Alston's Dissertation on the Sexes of Plants*, lately published in the first volume of *The Physical Essays of the Philosophical Society at Edinburgh*.

23. The polygamia class have a diversity of combinations of the male and female parts of their flowers, and many ways of fructification in the same species; some having male flowers and others female, each distinct and perfect in its kind; and others mixed or hermaphrodite, with both male and female organs

standing of this account of the several genuses of plants, I shall explain a few words mentioned in it: and first, concerning the signification of the petala of flowers. The late curious and indefatigable Mr *Petiver* thought it proper to make an *English* term of petala, by calling the leaves of a flower, the petals of it; for, as he observed, if a person was to ask for rose-leaves, they may be as well the green leaves of the tree, as the leaves of the flower; for which reason, where petals are used, either by him or myself, they are to be understood the same as petala, or the leaves of a flower, as the *Greek* expresses: but because most flowers abound in petals, or have more than one, so there are proper terms to signify the number of those petals, which are usually mentioned by botanical authors, where their numbers are expressed in *Greek*. First,

Monopetalous is a term used for a flower that has but one leaf, or has but one petal, as the campanula or bell-flower; so called because the petal or leaf of its flower is of one piece like the figure of a bell.

Dipetalous signifies a flower which has but two leaves or petals.

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organs of fructification in each: among the plants of this class are the orach, pellitory of the wall, ash, &c.

24. The cryptogamia class has its organs of fructification either concealed within the fruit itself, or so minute as to escape observation: to this class belong the mosses, mushrooms, ferns, &c.

This excellent botanist subdivides each of these general classes into orders, which he denominates monogynia, digynia, trigynia, &c. from the number of pistils or female parts of generation found in each plant.

The same celebrated naturalist has likewise distributed the vegetable part of the creation into different orders, from the structure of the calyx or cup of their flowers, for an account of which distributions and arrangements, the botanical reader is desired to consult his *Genera Plantarum*.

Tripetalous is a term for a flower with three leaves only.

Tetrapetalous expresses a flower with four single leaves or petals only.

Pentapetalous, a flower with five single leaves or petals.

Hexapetalous, a flower of six distinct leaves or petals; for the bell-flower is notched on the edges of the blossom, and many others have their blossoms cut or notched within a small way of the bottom; yet as these notches do not part the blossom into so many distinct leaves, it remains still a monopetalous-flower, or may be said to have but one petal.

Polypetalous signifies a flower that has many leaves, without any certain number. As,

Polyspermous is applied to any plant which bears many seeds, without expressing a certain number; so

Polyanthus is a proper term for a plant that brings many flowers, which is the true meaning of the word.

The novice in botany should in the next place be acquainted with the anatomy of plants, and have some ideas of the motion of their juices, which the following part of this introduction will attempt to point out to him.

For the use of these persons I shall begin with explaining the meaning of the word circulation, and open the case to them in as plain terms as possible; for without we have a right knowledge of this particular, all our attempts towards the improvement or preservation of vegetables, will be as uncertain as if a man was to undertake the practice of physic without any understanding or knowledge of animal anatomy.

First then, let us consider the word *circulation* with regard to its signification. It is taken from the *Latin* verb *circulare*, which signifies *to go round*. When we speak of the circulation of the blood in animal bodies, we mean the running of the blood through all the parts of these bodies from its fountain, and returning thither again;

again; and in these bodies, whenever that motion of the blood stops, death ensues; so that to preserve life in the bodies of animals, it is necessary that the blood be in continual motion through the vessels, and their several branchings, or ramifications, leaving as it passes by the several parts of the body, such juices as are necessary for the nourishment and support of each particular part; and at its passage by the fountain, renewing its former vigour, and taking in a fresh supply of wholesome nourishment, to make good what it has lost in its course, and to supply the same parts it did before, as it passes through them.

This motion of the blood through the arteries and veins round the body, is not in straight lines downward and upward, but by many thousand turnings and windings which correspond with every part of the body, so that no one part is neglected by the blood in its motion through it. We may observe in the foot of a frog, the tail of a neut, or of a fish, how finely the blood-vessels are disposed, so as to feed every part with due nourishment; and in the leaves of trees, especially in the leaf of the fig, we may easily discover the curious distribution of the sap-vessels for the nourishment of every part of the leaf; and that the fine net-work which we observe in that leaf, is composed of vessels through which the sap circulates or passes, is very evident, if we cut any one, or all of them, the milky-juice immediately shewing itself, and flowing from the vessels that have been cut.

The plant that shews us the flowing of the sap in the leaves, and other parts, somewhat plainer than the fig, though the vessels lie more concealed in the leaf, is the great garden-spurge, which I have cut and wounded in several parts, at great distances from one another, and thereby prevented the communication of the sap with some of the intermediate parts; so that if I made incisions in those intermediate parts, a minute or two after I had cut, cross one or two principal vessels

vessels which led to them, there would no milk flow from them. It is also possible, by ligatures, to stop the course of the sap, and prevent its passage into any part of the plant we incline; which to me is a proof, that the juices in plants have a motion throughout the whole plant, or circulate through it as the blood does through the bodies of animals, and not up and down only in straight lines, as has been supposed by several gardeners. Indeed there are in the woody parts of trees, straight upright vessels, through which, I suppose, the sap has a passage; but these vessels continue no longer straight than till they reach to a bud: then they branch forth and enter that bud to serve it with nourishment, till it is expanded and opened, and afterwards branch again into the several buds in that branch, and so on, till the tree is fully perfected.

At the same time we must take notice, that the vessels which I here mention passing through the wood, spread themselves, and are branched forth into the roots, and are inoculated into others; so that throughout the whole plant there are sap-vessels which maintain a correspondence between one part and another, from the extream parts of the top, to the extream parts of the root: so that there is the same reason to judge, that when any part of the tree is invenomed, or poisoned in its juices, the rest will be infected by it; as when some of the poisonous matter taken from the pustules of the small-pox, and inoculated in an healthful person, will soon after shew itself in several parts of the person so inoculated.

I have lately observed in a gentleman's garden near *Bristol*, some plants of the *Brazil-jessamine* which were grafted upon the common jessamine, whose leaves were strongly blotched with yellow; the *Brazil-jessamine* by this means is so extreamly tinged with yellow, that there is hardly any green to be found in its leaves; by which it is evident, that the poisonous juices which occasioned the blotches in the
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common jessamine, have by circulation mixt themselves with the healthful juices in the *Brazil*-jessamine, and have spread the distemper over the whole, which could not be done by any other means.

For the conduction of sap, there is a sponge-like body through which all the juices pass, and are thereby kept in their proper station, and defended from the sun, which would dry them up, were it immediately to come at them. This spongy body is composed of small vessels which are interwoven with one another, and having also a close communication with the vessels I have already mentioned, imbibe a certain moisture from the air, which is necessary for the good health of the plant: for we find, that if we shut up a plant in a close place, where it is deprived of air, it turns pale and sickly, and its leaves and shoots become faint and languid, even so as to bring death upon the plant: but this sponge-like body, which terminates in the bark of the plant, when it has the benefit of the air, keeps the plant alive, and helps it to resist the distemper, which it sometimes receives from the nourishment it takes in at the root, or by any other accident. And I find by experience, that when this spongy part is infected, which one may know by stripes of white or yellow appearing in the bark, there is no remedy, or, in other terms, there is no possibility of ever getting the stain out of the plant; though we were to inarch twenty healthful plants into it, and their juices were to circulate through it for a twelve-month: for all our return would be, to find that it would infect and tinge the healthful plants with its distemper.

But let us now see how differently plants are affected by distempers which flow in their juices.

First, We have plants which appear blotched with yellow in their leaves, only in the spring and in the autumn-seasons, but those marks disappear by the strength they gain in the summer; rue, thyme, pot-marjoram,

marjoram, and stone-crop, are often of this sort. This distemper is somewhat like the scurvy, itch, and such-like cutaneous distempers, which generally appear about the same seasons.

Secondly, We have plants that are continually blotched with yellow in the spongy part of their leaves, whilst the sap-vessels are of a pleasant healthful green; of such sort is the blotched-alaternus, the orange-mint, and some others. By strengthening these, by means of rich manure, or by inarching them into healthful plants, the distemper will be overcome, and the yellow colour changed into a lively green: this is somewhat like the jaundice in animals.

Thirdly, We have plants whose juices are so inveterately poisoned, that their distemper is continued from generation to generation; the leaves of some are maculated or spotted, others edged, others blotched, and others striped; such are the sycamore, bank-cress, self-heal, borage, archangel, water-betony, and striped-celery; all which being striped plants from the seed, I think their case is not much unlike what we observe in those animal bodies that are afflicted with such hereditary distempers as the evil, the leprosy, or the pox, sometimes happens to prove. We must observe however, that all the seedling-plants I speak of are not affected alike; some are more striped, some less, and now and then some few will come healthful, and be entirely green in their leaves. Surely this could never happen to such plants, whose very seeds do not escape being infected, if there was not as due a circulation and secretion of juices in them, as there is in animal bodies. I suppose it is hardly possible to eradicate such distempers in plants, without a considerable length of time, and a vast deal of fresh nourishment thrown into them.

This knowledge leads us partly to the cure of distempers in plants, and also will instruct us a great deal in the pruning them, and the seasons for it; nor does

does it inform us less of the cautions to be taken in the removal of plants, or in the strengthening our flower-roots for future blowing; for it has been experienced, that, in plants of the lower race, when they are cut down near the root, at a time when the sap is in its highest vigour, such plants have always been weak the following year and have sometimes perished.

As an illustration of what has been here related concerning the circulation of sap, I shall add a letter which some time since I sent to Dr *Douglas*.

SIR,

The *Turkish* method, which has been lately introduced, of inoculating the small-pox, has furnished me with many hints which tend to the further discovery of the circulation of the sap in plants.

I have in many of my writings given instances of the analogy between animals and vegetables, and have as often brought experiments to confirm the sap's circulation, and the generation of plants; both which discoveries, the more we know of them, the more it is in our power to improve our fields and gardens.

Mr *Fairchild* of *Hoxton*, who has been very diligent and curious in these inquiries, gave me lately two or three excellent observations of his own, concerning the sap of plants: he tells me, that having grafted the ever-green oak, or ilex of *Virginia* upon the common oak, the leaves of the common oak, which was the stock, decayed and fell off at the usual season of the year; but the ever-green oak, which was the cion grafted upon it, preserved its leaves, and continued shooting in the winter; so that when trees drop their leaves, the sap remains yet in motion, and is not gone into the root, as some people think.

An experiment of the like nature I made once upon the common laurel, or lauro-cerasus, which I inoculated upon the wild black-cherry; the leaves of the black cherry dropt about *September*, but the buds of
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the laurel shot or sprouted some time after, and remained green all the winter. To this we may add what we observe of the mistletoe or viscum, which is not only an ever-green, but whose fruit even grows and ripens a long time after the tree it grows upon sheds its leaves. Mr *Fairchild's* experiment indeed of the ilex is sufficient to shew that sap has a mode of circulation; and my own remarks serve to confirm it.

But let us proceed to explain this a little further, and from hence answer the objection which has been generally made against the circulation of the sap, viz. that at the fall of the leaf the sap always returns to the root. Whoever knows any thing of the circulation of the blood in animals, cannot be ignorant that there are arteries and veins through which it passes; the first to convey it from its fountain, the second to return it back; and that when this circulative motion is stopt, death ensues.

Every plant has vessels analogous to these, which perform the same offices: those plants which loose their leaves, and do not grow in the winter, are like those animals which sleep in the winter; but those plants which are ever-green and grow in the winter, are like the animals which have a continued life; and yet both of these have a circulation of juices performed through the same kind of pipes already mentioned.

Among the animals which sleep in the winter-season, we find that the urchin or hedge-hog, the bat and the rest, are laid to sleep at the approach of cold, which thickens their juices; and if we bring these creatures, in their sleeping-state, into a warm room, or near a fire, they recover their motion, and become brisker by degrees; but such as are in continued motion, or always have an opportunity of being so, are generally more dull and sleepy in the hotter seasons: so that this difference seems to depend upon the temper of the juices. And there are many experiments which prove that

that the difference of juices in all bodies is caused by the different frame and texture of those vessels or strainers they are filtered through, as I have remarked in another part of this work (b).

The ever-green oak has all the characteristics belonging to the common oak, but the dropping the leaves; and it is only the different model of the vessels in the one and the other that causes the variety of ever-green, and the contrary; the vessels in the ever-green dispose the juices to act with a less degree of heat, as those in the common oak dispose the juices to require a greater share of warmth for their growth. The shooting of the ever-green oak, the laurel, and the mistletoe in the winter, when the perdisols are without leaves, shew us they have vessels which frame different sorts of juices; and the difference of those vessels may be easily discerned with a good microscope.

The next observation of Mr *Fairchild* is, that by cutting a shoot of a fig-tree or a mulberry-tree, not only in the summer but in the winter, the sap runs out always at both ends, which shews that there are as well proper vessels for the return of the sap, as for it to rise through from the root; one end of the fore-mentioned branches exhibiting the returning sap, the other flowing with that which proceeds immediately from the fountain through the wood-vessels. This experiment he shewed to the Royal Society in the winter, which helps further to confirm the circulation of the sap. But any thing so new as this doctrine, which I first ventured to explain six years ago, cannot be too well supported by observations and experiments. I therefore shall add an instance or two more, before I begin to set forth the effects of inoculation.

That the sap even of those trees which lose their leaves, does not return to the root to lodge there in winter, is evident in the trunks of elms and other trees which are cut from the roots in winter, and even after

(b) See page 16.

after they are bored for water-pipes; many months after their fall, we find that they make shoots, and spring from every joint, as if they had a communication with the root, which they could not do if the sap had gone down to the root at the fall of the leaf. In this case one may observe that the pith is not of very great use for preserving the life or vegetation of a tree: I rather think it is the part wherein the flowers, fruits, and their parts are formed; for we never find it in its purity but in the younger shoots, of a year old, or two years at most, from whence it is conveyed to those sprouts of the tree which shoot from them: we find likewise, that in some plants there is scarce any pith discernible, as in the jessamine, the honey-suckle, and the vine, and also in the graminous or grassy tribes; but perhaps that defect is made good by nature in the knots of those plants, which I believe have a certain number appointed them for each shoot: I know that wheat and barley have four knots in each stalk, reckoning from the root to the ear.

Again, the vines, whose cuttings the gardeners set in the winter, when they commonly say the sap is down, have so dry a look at that time, that one who is unacquainted with the laws of nature, would imagine them to contain no moisture; but it is plain they are not without it, because they strike a root; and the root always proceeds from the natural moisture in the cutting or layer; and is enlivened or set to work by changing its element; and if we bring a branch from the air into the earth, or from the air into the water, it will alter its first design, and sling out roots where otherwise it would have put out branches.

In the next place we may observe, that every stick which we cut from a tree in winter, long after its yearly growth is finished, will push out its sap with a hissing noise at both ends, if we lay it upon the fire; so that it appears the sap was not gone down to the root, but was really in the stick and in every other
part

part of the tree : only it was not fluid enough in the open cold to push on the growth of the tree.

I remember once I saw some large elm-stakes drove into the ground to support a hovel, and one of them which was placed by the back of a kitchen-chimney, where a fire had been constantly kept, had shot forth into leaves about *Christmas*. These stakes, I was told, had been cut six weeks before I saw them, from a large trunk which had been lying in the farm-yard above a year. From this we may be assured that the sap is always in the tree as well as in the root, and that when the tree can have a right share of heat to keep the sap in a certain degree of fluidity, it will grow; and we find the case to be the same in those trees which are encouraged to grow and blossom in the winter, by artificial heats.

The experiments of the variegated common jessamine, whose leaves are edged with white, further declare the circulation of the sap. We find by inarching or inoculating that striped sort into either the plain common sort, or the *Spanish-jessamine*, or the *Indian* or *Brazil-kinds*, that the malignity, which causes the whiteness in the leaves of the first, mixes itself in such a manner with the juices of the plants it is ingrafted upon, that their leaves become infected and tinged in some places with the white colour, which in my opinion, is a plain demonstration of the sap's circulation: nay, if we put only a bud of the variegated sort into a plain jessamine, ten or twelve feet above ground, the poison will reach the branches next the root as well as those which are at as great a distance above it, and has also the same effect upon the ever-green sorts.

The curious Mr *Greening* told me, that he had seen some ash-trees that had been budded or inoculated with some buds of a striped ash; and that (though the buds had not sprouted) the shoots of the budded trees, which were below the inoculations, became variegated or striped. But it is necessary to remark, that there are three sorts of variegations or stripes in

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plants;

plants; that which seems to have the least share of distemper in it, shews itself in yellow spots here and there in the leaves of plants: but white is a sure sign of weakness and distemper; so that two leaves are never exactly marked in the same manner. This the gardeners call the yellow blotch.

The second is the white blotch, which commonly marks the leaves of plants with a great number of spots or stripes: those which lie next the extremities of the leaf are the whitest; and are, for the most part, accompanied with other marks of a greenish white, which lie deeper in the body of the leaf, even in the ramifications of the sap-vessels; but in neither of these cases is the woody part of the plant variegated. Mr *Fairchild* observes, that, where the leaves of a plant are striped in this manner, shewing three or four degrees of colour, there are hopes of its becoming what the gardeners call an edge; that is, to have its leaves edged with white, which, in gardening, is thought to be the most beautiful degree of striping, and has this certain property in it, that it will not by any means whatever be again brought to produce plain green leaves; the wood, the bark, and the fruit, are in this case always variegated, as well as the leaves. So powerfully has the distemper established itself in the tree, when its leaves are once edged with white, that its most noble parts are all tinged with the morbid matter, and there is no possibility of removing it; even the very fruit, its generative parts are infected, and its seed produces plants more or less partaking of the distemper of the mother-tree.

Where trees are blotched or spotted only with yellow or white, there is a possibility of recovering the plants to their genuine verdure, by inarching into them an healthful stock of the same species, and letting those stocks remain a year or two joined with them: the juices of the strong stocks will over-power the distemper, and sling out the vitiated juices through the

the pores of the leaves, which is a kind of transpiration. The strong stocks however may perhaps shew some marks of the distemper, by partaking of the uncorrected juices of the variegated plant; but this is not constant, the natural vigour of the stock sometimes is so powerful, that the venom it receives from the plant joined with it, is not presently to be discovered. I may also observe at this time, that I have joined healthful vigorous stocks with the old decaying trees, and have brought those old trees to recover their first vigour (*).

If we design to communicate the infected juices in great abundance to any plant which we have a mind should become striped, the method now in practice is, to chuse such stocks to bud or inarch upon, as have their leaves edged, which, as I have said before, are thoroughly distempered, and therefore are more capable of infecting the fresh plants inoculated or inarched upon them. A single bud or eye placed in the escutcheon of the distempered tree, where it can only receive its nourishment from the vitiated juices, will become variegated in proportion as it draws that nourishment more or less; and will partake more of the yellow or white juice, than if a branch was to be inarched: because the bud has nothing to nourish it but the juices of the plant it is inoculated upon; but by inarching, the cion is fed both by the striped plant, and a plant of vigour, which causes less striping.

The method of inoculating plants is not unlike the manner of inoculating the small-pox on human bodies: we open the bark of the plant we design to inoculate,

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until

(*) If a tree is by any accident barked or stripped all round, so that it cannot grow any longer, the proper method is to cut it off just above some principal branch; the stump must be cut off slanting and covered with clay, and the branch will soon become the body of a tree in the place of the other: the place where the stump is cut off being covered with a bark in the manner of a tree that is grafted.

until we discover the juices flowing from those vessels which act as veins, and then immediately apply the bud with part of the bark which joins it to the place we have opened; observing, that the bark adjoining to the bud has those parts with it, that according to nature's rules should be placed next to what I call the veins of a tree; we then bind it on, and let it remain till it begins to grow.

From these observations I think it is as evident that the sap circulates in plants, as that the blood circulates in animals, and that there is the same possibility of ingrafting distempers, and vitiating the juices of vegetables, as of poisoning or infecting the blood in animal bodies (d).

I am, Sir, Yours, &c.

R. BRADLEY.

To

(d) The notion of the circulation of the sap was entertained by several authors much about the same time, without any communication with one another; particularly M. Major, a physician at *Hamburgh*; M. Perrault, *Mariotte*, and *Malpighi*. It has met however with some considerable opposers, particularly the excellent M. *Dodart*, and the reverend and ingenious Dr *Hales*.

M. *Dodart*, instead of the same juice's going and returning, contends for two several juices; the one imbibed from the soil, digested in the root, and from thence transmitted to the extremes of the branches, for the nourishing of the plant; the other received from the moisture of the air, entering in at the extremity of the branches, so that the ascending and descending juices are not the same. One of his chief arguments is, that if two trees of the same kind be transplanted in one day, after first cutting off their roots and branches, and if after they have taken root again, some of the new shoots put forth each year be cut off one of them, it will not thrive half so well, notwithstanding its root and trunk being intire, as the other. This he conceives to be a proof of the plant's deriving nourishment by the branches, and concludes it to be of an aerial nature, being formed of the moisture of the air, dew, &c. whereas that imbibed from the soil is terrestrial.

Dr

To this I shall add the following account concerning the variegating of tulips, from whence I think the

Dr Hales, in his excellent *Treatise on Vegetable Statics*, presents us with various experiments serving to prove that the sap of plants does not circulate. Among other observations, he remarks, that when the sap has first passed through that thick and fine strainer the bark of the root, we then find it in greatest quantities in the most lax part, between the bark and wood, and that the same through the whole tree. And if in the early spring the oak, and several other trees, were to be examined near the top and bottom, when the sap first begins to move, so as to make the bark run and easily peel off, he believes it would be found that the lower bark is first moistened; whereas the bark of the top branches ought first to be moistened, if the sap descends by the bark. As to the vine, he says, he is pretty well assured that the lower bark is first moistened. He adds, that it is to be seen in many of the examples of the experiments he has given in that book, what quantities of moisture trees daily imbibe and perspire. Now the celerity of the sap must be very great, if that quantity of moisture must most of it ascend to the top of the tree, then descend, and ascend again, before it is carried off by perspiration.

The defect of a circulation in vegetables seems in a great measure to be supplied by the much greater quantity of liquor which the vegetable takes in than the animal, whereby its motion is accelerated: for by the first example he gives, we find the sun-flower, bulk for bulk, imbibes and perspires seventeen times more fresh liquor than a man every twenty-four hours. Besides, nature's great aim in vegetables being only that the vegetable life be carried on and maintained, there was no occasion to give its sap the rapid motion which was necessary for the blood of animals. In animals it is the heart which sets the blood in motion and makes it continually circulate; but in vegetables we can discover no other cause of the sap's motion but the strong attraction of the capillary sap-vessels, assisted by the brisk undulation and vibrations caused by the sun's warmth, whereby the sap is carried up to the top of the tallest trees, and is there perspired off through the leaves: but when the surface of the tree is greatly diminished

the most stubborn opposers of this doctrine may be convinced.

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nished by the loss of its leaves, then also the perspiration and motion of the sap is proportionably diminished, as is plain from many of the Doctor's experiments : so that the ascending velocity of the sap is principally accelerated by the plentiful perspiration of the leaves, thereby making room for the fine capillary vessels to exert their vast attracting power ; which perspiration is effected by the brisk rarefying vibrations of warmth, a power that does not seem to be any ways well adapted to make the sap descend from the tops of vegetables by different vessels to the root.

The instances of the jessamine-tree and of the passion-tree, which have been looked on as proofs of the circulation of the sap, because their branches which were far below the inoculated bud were gilded, the Doctor takes to be of no weight : because that we have many visible proofs in the vine, and other bleeding trees, of the sap's receding back, and pushing forward alternately at different times of the day and night ; and there is great reason to think that the sap of all other trees has such an alternate receding and progressive motion, occasioned by the alternacies of day and night, warm and cold, moist and dry. For the sap in all vegetables does probably recede in some measure from the tops of the branches, as the sun leaves them ; because its rarefying power then ceasing, the greatly rarefied sap and air mixed with it will condense and take up less room than they did, and the dew and rain will then be strongly imbibed by the leaves, as is probable from several of the Doctor's experiments, whereby the body and branches of the vegetable, which have been much exhausted by the great evaporation of the day, may at night imbibe sap and dew from the leaves : for by several of the foresaid experiments, plants were found to increase considerably in weight in dewy and moist nights.

As to the argument for the circulation of the sap, grounded upon the experiment of some sorts of grafts infecting and cankering the stocks they are grafted upon, the Doctor disproves, by fixing mercurial gages to fresh cut stems of trees, whereby it appears that those stems were in a strongly imbibing state, and consequently the cankered stocks might very likely draw sap from the graft, as well as the graft alternately from
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S I R,

I have lately had an opportunity of viewing and considering several collections of breeding tulips, and have gathered a few remarks concerning them, which
hitherto

the stock, just in the same manner as leaves and branches do from each other in the vicissitudes of day and night. And this imbibing power of the stock is so great, where only some of the branches of the stock will, by their strong attraction, starve those grafts; for which reason it is usual to cut off the greatest part of the branches of the stock, leaving only a few small ones to draw up the sap.

The instance of the ilex, grafted upon the *English-oak*, seems to afford a very considerable argument against a circulation: for if there were a free uniform circulation of the sap through the oak and ilex, why should the leaves of the oak fall in winter, and not those of the ilex? That the sap does not descend between the bark and the wood, as the favourers of a circulation suppose, seems evident from hence, *viz.* that if the bark be taken off, for three or four inches breadth quite round, the bleeding of the tree above that bared place will much abate; which ought to have the contrary effect by intercepting the course of the refluxent sap, if the sap descended by the bark. But the reason of the abatement of the bleeding in this case may be well accounted for from the manifest proof we have in these experiments, that the sap is strongly attracted upward, by the vigorous operation of the perspiring leaves, and attracting capillaries: but when the bark is cut off, for some breadth below the bleeding place, then the sap which is between the bark and the wood below that disbarked place is deprived of the strong attracting power of the leaves, &c. and consequently the bleeding wound cannot be supplied so fast with sap as it was before the bark was taken off. But the most considerable objection against this progressive motion of the sap without a circulation arises from hence, *viz.* that it is too precipitate a course for a due digestion of the sap in order to nutrition; whereas in animals nature has provided that many parts of the blood shall run through a long course before they are either applied to nutrition, or discharged from the animal. Yet when we consider that the great work of nutrition in vegetables as well as animals (that is after the nutriment is got into the veins and

hitherto has been but little observed, though I believe the breaking or striping of tulips very much depends upon them.

First, We are to observe that a tulip does not preserve its root two years together, but the root that was taken out of the ground last year, is quite lost this year, in the leaves, stem, flower, and seed; and while

arteries of animals) is chiefly carried on in the fine capillary vessels, where nature selects and combines, as shall best suit her different purposes, the several mutually attracting nutritious particles, which were hitherto kept disjointed by the motion of their fluid vehicle, we shall find that nature has made an abundant provision for this work in the structure of vegetables, all whose composition is made up of nothing else but the innumerable fine capillary vessels and glandulous portions or vesicles. Upon the whole, Doctor *Hales* thinks we have from his experiments and observations sufficient ground to believe that there is no circulation of sap in vegetables, notwithstanding, many ingenious persons have been induced to think there was, from several curious observations and experiments, which evidently prove that the sap does in some measure recede from the top toward the lower parts of plants: whence they were with good probability of reason induced to think that the sap circulated.

Blair, who maintains the circulation of the sap, is of opinion, that there are certain parts of plants which have their peculiar juices, and maintain a circulation in themselves, independent of the rest of the plant. The fleshy and thick roots of some plants, and the fruits of others, are of this number of peculiar parts. This is analogous to what we see in some parts of animal bodies also. On this scheme, the bark, the wood, and the pith of a tree, may be compared to the bones, the skin, and the marrow of animals: while the nourishment is sent in abundance to one part of these, it is allowed more sparingly to the rest. Thus while a young tree shoots out its tender boughs in spring, the juice ascends upward to them from the root; but when these have acquired their due length, the motion of the sap is determined upwards with less violence, and the bark and wood are nourished and increased by it. This is the reason why in spring trees grow in height, and in autumn increase in thickness.

while these parts are growing, and by that means diminishing the root they spring from, the juices which circulate through them, are framing a fresh root bordering upon the place where the first was: so that when the plant has performed all its summer-work, there remains no old root at all, but the flower-stem sticks to the side of the new-made root. You may be sure this root is new, because the stalk stands on the outside of it, and every one knows that the flower-stalk always comes out of the middle of the root that was planted.

While tulips are under several degrees of growth, from the very first putting forth of the leaf the root declines daily, and a new root is forming itself and daily increasing; and when the flower and seed are fully perfected, the old root is entirely wasted, and the new one compleated (e).

To

(e) Tulips are generally divided into three classes, according to their times of flowering; the early, the middling, and the late. The early ones are not near so high as the late, but they are valued for their earliness as they flower in *February*. The roots of these are to be planted in the beginning of *September*, under a warm pale or hedge. The proper soil for them is pasture-land, with the turf rotted among it, and a mixture of one fourth part sand: this should be laid about ten inches deep, and should be renewed every year. If the weather is very severe when they first appear, they should be covered with mats, as also at night, when they are in flower, if it be very frosty. When their flowering is over, and their leaves decay, the roots should be taken up and laid in a dry place, and afterwards cleaned and laid up safe from vermin till the *September* following.

The late blowers are propagated from what they call breeders, which are plain flowers brought over principally from *Flanders*, and these by culture are changed into striped or variegated ones. They are also propagated by sowing the seeds; but this requires great care, as in the raising all other fine flowers from seeds. The seeds must be saved from the choicest flowers, and sowed in shallow pans or boxes of earth

in

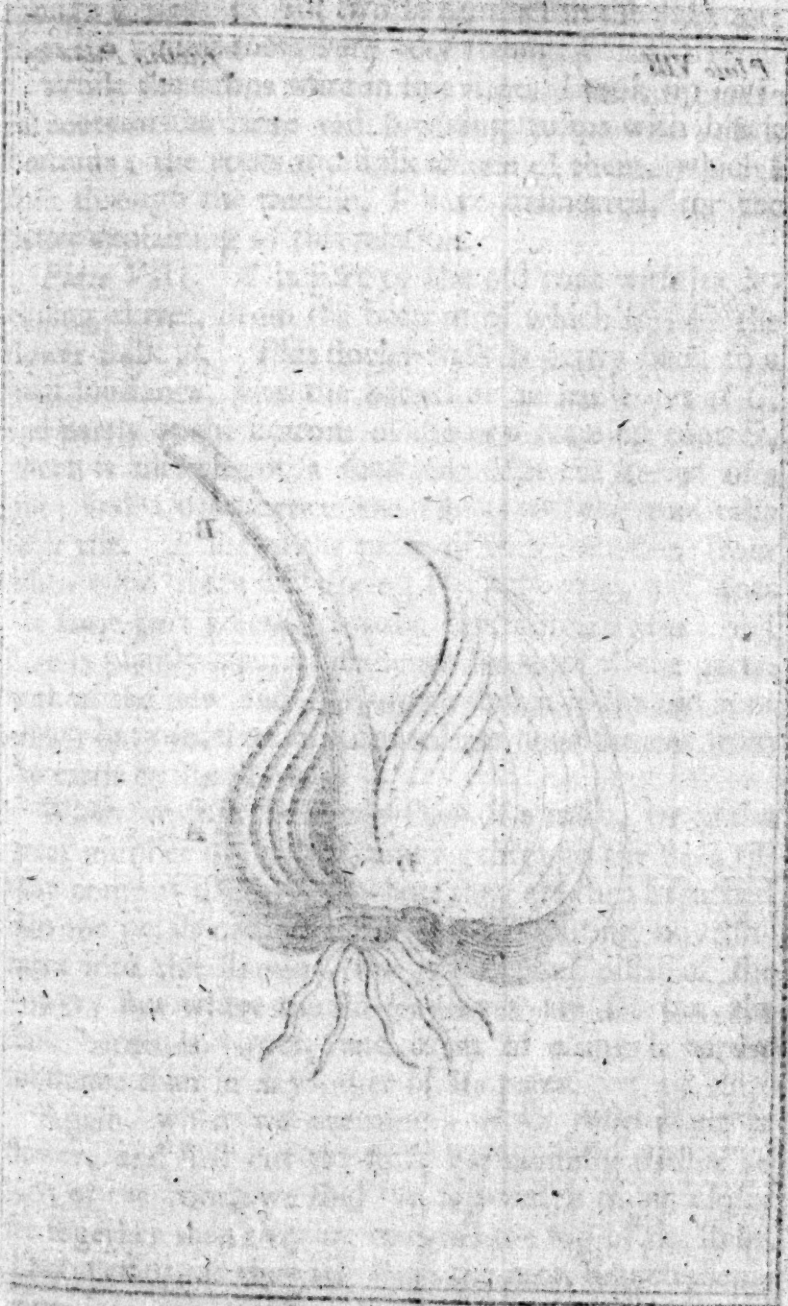
To discover this, I took up several tulip-roots in different degrees of growth, and in proportion to the times they severally required to perfect their seed, I observed that the new roots were greater or smaller, as there was less or more of the old root left. Before the flowers were coloured, I found the old roots were but half decayed, and the cloves in those roots on the outside began to dry.

When

in *September*. The spring following they appear like the leaves of grass or young onions; and after standing two or three months, these decay. The boxes are to be kept clear of weeds, and removed to different situations, where they may enjoy the morning sun and be defended from sharp winds and frosts. At the *Michaelmas* of the following year, they are to be removed out of the boxes into beds, where they should be planted two inches deep, and at two inches distance from one another. In *October* an inch depth of new earth should be sifted on them, and they are to remain two years in these beds. At the end of this time they will flower, and the best of them must be marked with sticks, that their roots may be distinguished when the leaves are decayed.

The breeders being thus raised are to be shifted every year into fresh earth, and they will in time break out into very fine stripes. The earth they are planted in should be every year of a different kind. The beds must be laid eighteen inches deep with pasture-land as before directed: this should be laid in first ten inches thick, and on this the roots should be placed in regular order, and at even distances, and then the remaining eight inches should be laid over these; the top of the bed being a little rounded to throw off the wet. Thus they are to remain till the buds appear; and then, if the nights are very severe, they are to be sheltered by covering them with mats. The flowers which break out into fine stripes here should be separated afterwards from the rest; and if they hold on their beauty to the last, they will never return to plain flowers again, and the off-sets from the roots of these will always produce such flowers. When the tulips have flowered, their heads should be broken off, to prevent their seedling, which would make them flower much the worse the next year. *Miller.*

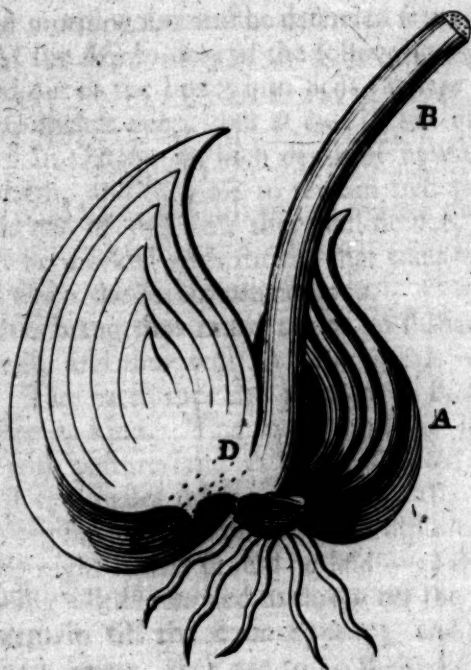
PLANT. PHYS. TAB. VII. 1687.



PLANT. PHYS. TAB. VII. 1687.

Plate VIII.

facing Page 251



When they were in full bloom, the cloves that remained were all inclining to dry, and there were three, though sometimes but two in number in the old root; then the young roots were very strong.

While the tulips were in this state, I took up several roots of the large red breeding tulips with black bottoms; the roots and stalk of one of them, which I split through the middle, I have delineated, for the better explaining of this relation.

Plate VIII. *A* is part of the old root with its declining cloves, from the bottom of which springs the flower-stalk *B*. This flower-stalk is partly fixed to a hard substance, like the kernel of an hazle-nut at *C*, and partly at the bottom of the new framing root *D*, which is likewise of a substance like the kernel of a nut; and from thence the cloves of the root take their rise. *E* shews the point of the new root, from whence the fibres will spring the next year, as *C* does the same part where grow the fibres of this year: and here is plainly a correspondence between all the parts, both of the new and old roots; but it is the old root which only receives the immediate nourishment from the earth by its fibres.

When we split the flower-stem of a tulip, we find a great number of vessels running through the stem till they come at the flower, where they are then branched into the petals or flower-leaves, distributing nourishment into the stamina, the apices, and pistil of the flower; but where the flower-leaves are set on, the stalk becomes larger, and turns of a much harder substance than in any other of its parts.

Again, when we examine a whole tulip-plant in flower, and first cut the stalk horizontally within an inch of the root, we find the sap-vessels much closer set together than they are towards the top of the stem. These vessels, as they rise from the root, branch themselves into the leaves which grow upon the several parts of the stalk.

I infer

I infer from these observations: *First*, That all the parts, *viz.* the flower-stem, the leaves, the flower, and the seed, are all perfected from the very root that we put into the ground, and prove more or less luxuriant, as the soil is more or less favourable to the tulip; the nourishment the tulip receives from such a soil is taken in by the fibres.

Secondly, That by the wasting of the old root, and the growth of the new one, which both correspond immediately with the flower-stem, it is plain that the sap circulates through the whole; for the new root has no fibres to nourish or make it grow from the earth: therefore it can be nourished only from some vessels in the stem upon the return of the sap which goes up from the old root, and this return of sap must be constant, as the growth of this new root is constant: for was this new root to be nourished only at set times, it would lose in the intervals what it gained at the times of its nourishment; but experience shews us the contrary.

Thirdly, This new root grows till the flower and seed is perfected, and then the old root is quite decayed, the flower-stalk dries, and parts from the new root without difficulty, which it will not do while the stalk is green and the juices flowing in it.

Fourthly, We are to observe, that it is from the new root we are to expect the change or alteration in the stripes of the flower; and though the root we put into the earth for blowing this year, should bring a plain flower, yet, by the want of nourishment which may happen to it from being planted in brick, lime, or stone-rubbish, the parts which are framed in the new root may be so modelled as to bring its flower into stripes the next year. Therefore when we plant plain tulips in rubbish, to make them break into colours, we must not expect to see any alteration the first year, for it is the new roots, which are formed in the rubbish-soil, that must blow to shew the effect of planting

planting in such a soil. The old roots had already in them their fixed properties before we put them into the ground, which could admit of no alteration but of blowing taller or lower, as they had more or less nourishment from the soil they were planted to blow in.

It may possibly be, that some of the tulip-roots which we planted last *September*, might bring striped blossoms this year; but then we have good reason to suppose, that those stripes were regulated in the roots that were made the year before.

It is observable, that some tulips, already broke or come to strike, will one year abound in the dark colours, and the next year will come finely marked, as that tulip which is called the *Vulcan* will do. I conceive therefore, that while a tulip blows with a very large share of the dark colours, the new root has imbibed a large share of those juices which will afford the brighter colours, and so on the contrary; for in those tulips which are called breeders, I observe that the mass of colour in their flowers, before they break, is a compound of several colours that simply appear in their stripes when they come to break; and that these breeders cannot break into any stripe of colour but what is of one or more of the colours which make the compound mass in their plain flowers. As for example :

The bagget primo, which is counted one of the best breeding tulips, brings its plain blossoms of a pale purple, wherein is a large share of white, a moderate share of a deep lake-colour, and a small share of blue. These three colours rightly blended together, will make exactly the colour of the flower of this bagget. And when this flower comes to break and stripe, which happens from these colours being separated, then the stripes are always of those colours which were used to make the compound colour in the plain flower of that sort.

When

When the lake is quite alone, it shews its galaxy; when mixed with a great share of blue, it is much darker; when with a great share of white, of a flesh colour; and the blue and white brings a slay-colour; and so the stripes will produce as much variety as can be made from mixing these colours in different proportions with one another. The reason why these colours come to be separated, seems to be from the structure of the vessels which are formed in the new root, some being made in such a manner as to receive only such juices as will yield one colour, and another such as will yield another colour, just like the vessels in animal bodies; some yielding red, as in the veins; some white liquor, such as milk in the breasts; and others, such as are of the colour of urine. Now, I say, it is as plain that there are vessels in plants for the circulating and secreting of juices, as that there are vessels in animals which distribute and separate juices in every part of their bodies.

It also seems necessary that this circulation of juices should be continued in the tulip until it has performed all its offices, such as perfecting its flower-stalk, its leaves, its flower, &c. for the better adapting the new-forming root to the same mode of growth, and imprinting in it every natural perfection of the original it took its rise from; therefore I suppose it is that the new root continues growing all the time that the old one is performing its offices, that the principles of every part may circulate through it.

But the next breeding-tulip which I shall take notice of, is that which is called the *beau regard*, which is of a much paler purple than the *bagget primo*; its mass of colour is composed of a very small share of blue, a great deal of white, and about as much of the deep lake-colour as of blue. This flower, when it comes to stripe, shews the colours separately that the plain flowers are composed of, as the *bagget primo* has done before.

The

The breeder which is called van porter, has its plain flowers of a reddish purple, where the lake prevails more than the blue, and there is less white than blue; the various colours which may be produced from these three colours, may be expected in those of this sort which become striped.

The great *Dutch* red breeder, with the black bottom, has its plain flowers of a dirty red colour, though composed of two colours which are separately as beautiful as can be imagined, that is a fine yellow, like that of gamboge, and a carmine-colour; but when this flower stripes, and the colours are somewhat separated, the variegations are extremely fine.

The *Dutch* red breeder, with a yellow bottom, is of a darker colour than the former; the colours which compose the mass are such as make the former; but in this there is a little black intermixed, and when it breaks, its stripes partake only of the colours in the mass, either simple or compound, like the others before mentioned.

We observe sometimes that the white is very prevailing in a flower when it breaks; and spotted only here and there with other colours, which were blended in the mass of the plain breeder; one may then not unreasonably suppose that the new-forming root possesses those juices which make the darker colours, and will shew them in its flower the following year.

Having now gone through my observations concerning the growth of tulips, I shall recommend to your trial a thought or two, for making the colours separate in plain tulips, and bringing those stripes which make them so much admired: and that the colours of the flowers circulate with the juices all over the plant, seems certain to me, on account of those green leaves which are now and then, upon certain occasions, tinged with scarlet, yellow, and other colours, only common to the flowers on whose stalks they are found. And that these colours, or their rudiments, likewise circulate

culate through the new root in some proportion, is evident, because that root produces flowers partaking of the same colours of the flower produced by the old root.

As the vessels which correspond between the old root and the flower, and between the flower and the new root, are all of them in the flower-stem, I am of opinion, if we could pinch some of them without wounding them all, or arrest the sap, so that it should not circulate with its wonted freedom, that the new-forming root would by such checks be brought to separate its colours in such a manner as to produce stripes of those simple colours that composed the compound colour in the mass. One way of doing this may be by binding the flower-stem pretty hard with packthread a little before the flower opens; for this binding will, in my opinion, either press or wound some of the sap-vessels so much, that the circulation of the sap will be prevented in them, and the new-forming root by the want of circulation will become varied from the old root; or if by a fine lancet one could cut a few of them, it might perhaps have a good effect; but whether they would not heal or close again, I am in some doubt. The vessels I would advise to be cut, lie just within the thin skin of the flower-stem; but I think the pinching of them with packthread is the surer way.

There have been many trials made to alter the colours and properties of tulips, as steeping the roots in liquors of several colours, putting powders of several colours into the cloves of the roots, and planting them in coloured earth: but these trials have all proved useless, as well as that of drawing coloured silks of several sorts through the roots to stripe their flowers. The experiment which I propose cannot hurt any of your roots.

We may also observe, that now and then we shall find a root formed upon the flower-stem an inch or two above ground, which seems to discover that in the

the same flower-stem are principles of all the parts that belong to a tulip-plant, and those could not all be in that part unless the sap circulated throughout the whole plant.

I shall conclude this letter with an experiment of *Charles Dubois*, Esq; whereby he shewed me a clear proof of the sap's circulation in the great garden-spurge: for immediately, upon cutting off a little shoot from this plant, the wounded vessels in the stalk emitted so large a quantity of milky juice, that it continued dropping for near two minutes, till the air and sun thickened it so much that it stopped the mouths of the wounded vessels. And that this sap flows through vessels which have their rise in the root, and have a correspondence with others which return, is evident in the leaves of a plant without the help of a microscope; but especially if we cut one of the leaves a-cross with a pair of scissars, the milk will immediately shew itself at the mouths of those vessels which are wounded.

The apocynum or dog's bane, which has milky juices, will also shew us the same thing, especially those which have the largest leaves, and are the quickest growers; and I am apt to think that some of them have leaves transparent enough for us to discern the milk circulating through them, as we do the blood in the webbed part of a frog's foot, or a fish's tail; but the leaf we examine must be growing upon the plant while we make the observation, and the microscope fixed in some frame to be kept steady; we may also use a lamp to help the discovery.

The same vessels which serve to convey this juice through the leaves of plants, may be easily observed on the back of the fig-tree leaf, where we shall find that they are all branched into one another; and what sap flows through one, corresponds with all the rest; so that the juice which comes into the vessels in the leaf, through some of the pipes or vessels in the foot-stalk, circulates through all the vessels in the leaf, as

well downwards as upwards, as the following experiment will demonstrate. If we cut or stamp a small hole between any two of the capital vessels in the leaf, we shall find the white sap flow from the wounded vessels on one side, or about half the circumference of the hole we have cut; but it will rarely issue from the other vessels that are wounded, because the communication is broken: yet if we make several of these small holes in a leaf, without cutting the larger vessels, we shall find the vessels in some flinging out juice towards the root of the leaf, and some flowing with juices from the foot-stalk towards the upper part of the leaf, so that the sap is running through all the branches of the vessels, whether up or down, at the same time; and the plant is increased in bulk, by taking into all its parts such shares of the circulating juices as each is appointed to receive.

I am, SIR, Your most humble Servant,

R. BRADLEY.

From the foregoing observations we may judge, that as in animal bodies there are several degrees of juices, which are more or less refined, according to the largeness or smallness, or perhaps figure of the vessels they pass through; so in plants we find vessels of different functions, which, like filters of different kinds, separate and alter the juices that pass through them, so that they may separately be distinguished by the senses, although they all originally proceed from the same fund of undigested juice in the root; and the more time these juices have to open and nourish the several parts they pass through, so both the parts and juices become more perfect, and draw nearer the point of maturity, which nature has fixed for their perfection. In this progress those parts equally ripen, which are to be acted upon, as those do which are to act.

It is necessary to observe in this place, that the raw undigested juices of plants do not reside in the bearing branches of trees; so that in such cions as we use for grafting, we should always chuse those whose juices are in a bearing condition; and so when we expect plants to bear quickly from layers, those layers must be raised from shoots which come from wood where the juices are digested and ripened.

But some may object, that all plants cannot be raised by layers, and if even grafting on the roots of other plants would do to propagate trees, yet those roots so grafted would not perhaps have sap in them sufficiently disposed to bring the grafts to a speedy bearing. But in answer to this, we are only to consider the roots, which we use for this purpose, as so many funds of vegetable matter, which is to be filtered through the vessels of the cions, and digested and brought to maturity, as the time of growth in the vessels in the cion directs; for a cion of one kind grafted upon a tree of another sort, may be said rather to take root in the tree it is grafted on, than unite itself with it; for we see the cion preserve its natural purity and intent, though it feeds or is nourished from a meer crab, which is certainly occasioned by the difference of the vessels in the cion from those in the stock: and therefore we may compare grafting very justly to planting. A dozen of heart cherry-trees, for example, planted in as many different soils, each of these trees, though the juices of the soils are all different, will yet preserve its natural bent of bearing heart-cherries: or do the physicians always take notice, that any particular herb alters its virtue for being cultivated either in sand, clay, gravel, or any other kind of land; generally supposing that the strainers of every distinct species of plant so modify the juices of the earth it grows in, as to afford the same virtues in all of one sort, let the soil be never so different?

By Dr Grew's and Malpighi's *Anatomy of Plants*, as well as by those plants I have traced with the microscope, one may discover parts in each distinct plant, of very different frame and texture from one another; and then we may as surely conclude, that those parts differing from one another, are designed by nature for different functions; for it would be as unreasonable to suggest, that all the parts of a plant do the same office, as it would be to suppose, that a bone acted the same part as an artery, an artery as a muscle, a muscle as a vein, or a vein as the lungs of an animal; and, in my opinion, there is nothing more necessary than a right understanding of the anatomy of plants, for those who would cultivate them; for how would it be possible for a physician to cure the distempers incident to human bodies, or prescribe them rules of health, unless he first knew their frame and constitution?

Among plants it must be as impossible to improve their growth, or give them (or preserve in them) a state of health, as in the case of animals, if we do not consult their frame and texture of parts, and the natural food or soil they require; it is therefore upon this account that I shall take occasion to hint some few remarks relating to the parts which are generally observed in them.

Dr Grew tells us, that all kinds of vegetable principles are at first received together into a plant, but are afterwards separated, *i. e.* filtered, from one another, in very different proportions and conjunctions by the several parts; so is every part the receptacle of a liquor, become peculiar not by any transformation, but only the percolation of parts out of the common mass or stock of sap; and those which are superfluous in any plant, are discharged back by perspiration.

The same learned Doctor ascribes to every different kind of vessel a distinct office: he tells us, the lymphæducts,

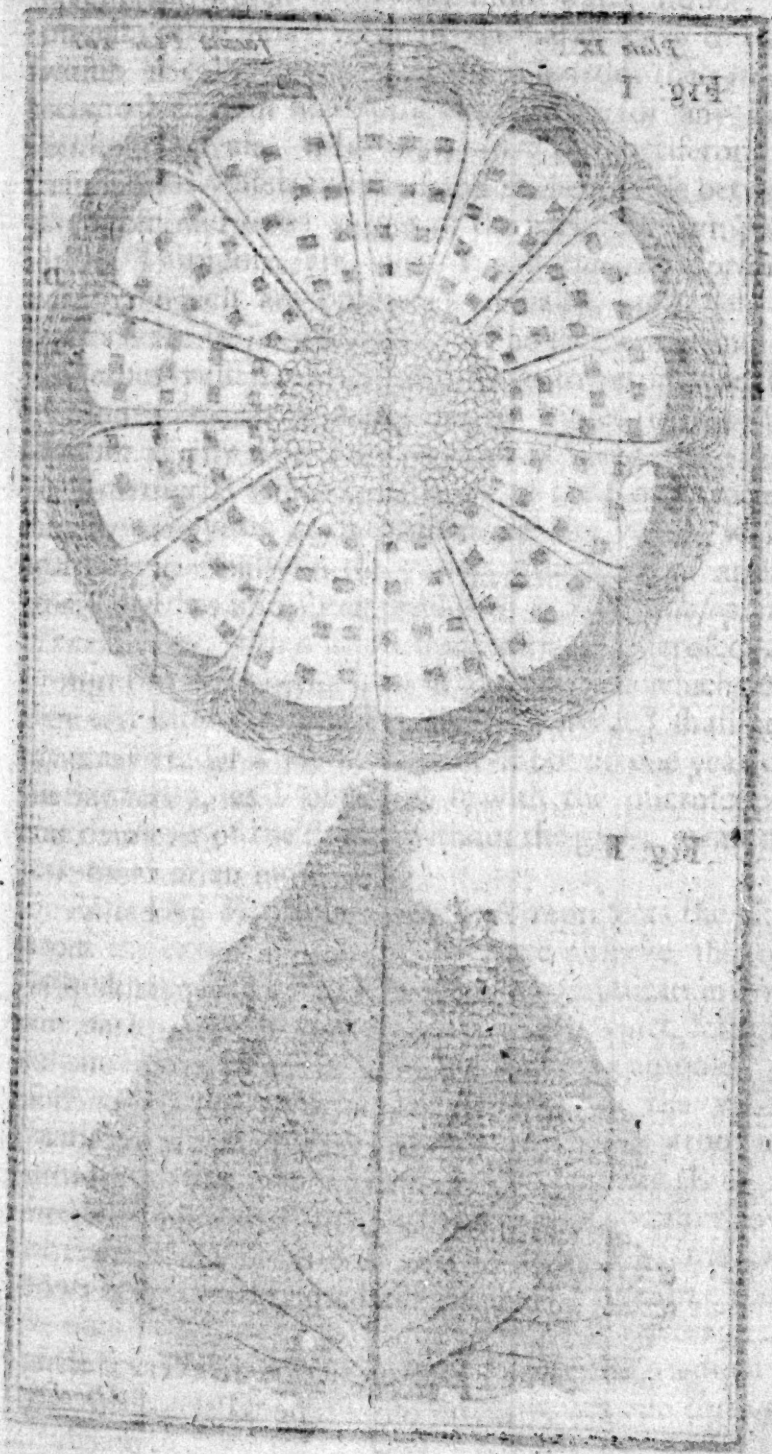


Fig: I

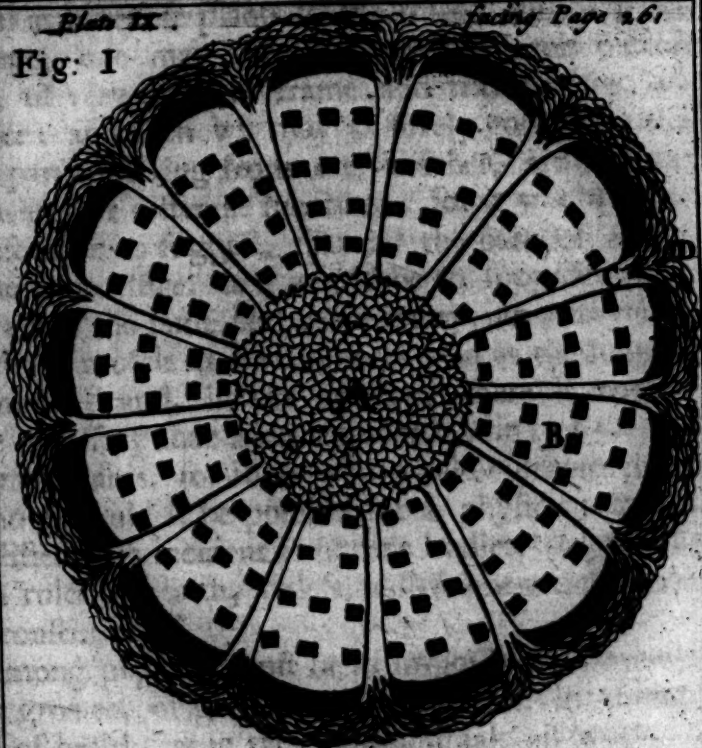


Fig. II



phæducts, which carry the most watry liquor, are placed on the inner verge of the bark, next to those which he calls air-vessels, I suppose from their smallness, which will not admit the passage of any fluid denser than air. He adds, that the lactiferous or resiniferous vessels usually stand in the middle between the inner and outer verges of the bark: his lymphæducts, I suppose, are what I call the new forming vessels, which are produced annually, and help to increase the bulk of the tree. The lactiferous and resiniferous vessels, I suppose, serve to return the superfluous sap, as I have already hinted in the first chapter of my *New Improvements of Gardening*; and in a memorial which I delivered to the Royal Society about three years ago, concerning the vessels which run longitudinally in the young shoots of an apple-tree, and has since been published in *The Philosophical Transactions*, with a figure done with the microscope.

But to give a better idea of those vessels which convey and filter the several juices in a tree, I shall here give my reader a view of a vine-shoot of one year cut horizontally, as I observed it with the microscope; the diameter of the shoot, without the glass, measured one third of an inch.

Plate IX. Fig. I. The circle A represents the pith, from the extreme parts of which we observe thirteen latitudinal vessels, which have a communication with the bark; one of them is marked C, which loses itself in D or the bark, that seems to be composed of fine capillary vessels. I observed that the vessels marked C were not at equal distance one from another, which make the spaces between them B of an irregular figure. In each space B, we find four rows of spots of unequal forms and magnitudes, the two rows next the outer verge have constantly three spots in each line, but those next the pith only two apiece: these spots represent the orifices of the longitudinal or air-vessels, as Dr Grew calls them, which run through

the woody part, and which, I suppose, filter the finer juices of the plant. At E we discover some passages capable of containing liquor as dense as water; these, I suppose, serve to return the superfluous sap to the root, and, I suppose, are Dr *Grew's* lymphæducts.

When we have observed this figure of the wood, I conceive it will not be improper to give my reader a view of the beautiful texture of a leaf, as it was dissected by the insects that blighted it; which were so very small that they were only capable of eating the most tender parts, and leaving such minute vessels untouched, as are scarce discernible without a microscope.

Ibid. Fig. II. Shews us the texture of a full-grown leaf of the lime-tree, whose fleshy part was destroyed by small insects. In this we may not only observe the ramifications of the sap-vessels, which hold a close communication with each other, but in several places discover the egg-nests of the insects which devoured the fleshy parts. Dr *Grew* observes, that the fibres of a leaf are composed of the two general kinds of vessels, viz. for sap and air; and these, as well as other vessels in plants, are ramified out of greater into less, as veins and arteries are in animals. It is likewise the opinion of some great men, that the vessels in the leaves of plants are inosculated not side to side, but the ends of some into the sides of others; but this is not really the case: for the smaller threads being only so far deducted as sometimes to stand at right angles with the greater ones, they are only inosculated end to end, or mouth to mouth, after they are come at last to their final distribution.

It is to be observed farther, that the vessels are the chief viscera of a plant, and as it has several liquors, those liquors become differently qualified from the divers kinds of vessels; and that as the viscera of an animal are but vessels conglomerated, so the vessels of a plant are viscera drawn out at full length.

Moreover,

Moreover, it is remarkable in many cases, that the multitude and largeness of the vessels produce a sweet and winey sap, and the fewness and smallness of them an oily aromatic sap. Doctor Grew supposes, that the odours in plants proceed chiefly from the air-vessels in the wood; not but that the rest do also yield their smells, which are perceptible in fresh, undried, and unbruised plants: for, says he, the air bringing a tincture from the root, and from the several organical parts along with it, and at last entering the concave part of the air-vessels, it exists there. It is not to be denied, that the effluvia, which can be admitted into the wood-vessels, may give a smell to the wood, and that as that vapour passes through vessels of different structure, so as to alter the form of their parts, so in every one of its changes it will yield a smell different from the rest: the smell of the wood will be different from that in the bark, the juices in the one being more essential than those of the other; but both being bruised and mixed together, yield a scent differing from either of them singly. So the leaves give us a scent different from either of the former, as the flowers do from that in the leaves, and the fruit from that of the flowers. It is necessary, moreover, to the nutrition of plants, as in animals, that there should be a concurrence of two specifically distinct fluids: these, says a learned author, with good reason, are interwoven in every part of a tree in their proper vessels, like linsy-wolsey; so that every the least part of the sap is impregnated with divers essential tinctures, as it is continually filtered from the fibres of one kind to those of another. We may observe (*Plate ibid. Fig. I.*) very plainly, the insertions of the cortical body as they run from the centre to the circumference, which in other subjects are visibly braced and interwoven together, by capillary tubes, with the longitudinal vessels of the wood, and by that

means constitute a firm body, as the timber of any tree.

From hence we do not only learn, that in all plants there is a necessity of two specifically distinct juices to act upon one another, but that these in their action are filtered or refined, altered and changed, according to the parts they pass through; and also that in some parts they sooner ripen and become prolific than in others; they are also more grateful to the smell in some parts than in others: nor is this all; this mixing, filtering and ripening, sooner or later, of the juices, give difference of colour to the several parts of the plant, and are seemingly the occasion of most of the alterations which we find in the several parts of trees.

Dr *Grew* supposes the chief governing principle in the juices of plants to be the saline; which saline principle he tells us must be understood as a generic term, under which divers species are comprehended. The vegetable salts seem to be four, *viz.* the nitrous and acid, alkaline and a marine; arguing, first, from the cuticular and other concretion, commonly called mouldiness or mother, in liquors distilled from herbs, vinegar and such-like; for in these, says he, there is a tendency to vegetation, and many of them are true vegetables, as Dr *Hook* has observed in his *micrographia*, and has been confirmed by others. Now the liquors where these are found, do wholly, or in part, lose their taste and smell, and become vapid, the more sensible principles therein having made their transit from the fluid into the concrete parts.

But in a more particular manner my author observes, that the nitrous salts seem to be assigned by nature chiefly for the growth of plants; the other three salts are exhibited by the several ways of resolving the principles of a plant, some in their natural state yield an acid juice; others by fermentation, and most

most by distillation in a sand-furnace, yield an acid liquor.

By calcination, all plants yield more or less both of a fixed and volatile alkalous salt, the first in the ashes, the latter in the soot; but the marine salt is obtained no other way but from a solution of the alkaline upon its being exposed to the air.

The diversity of salts found in one plant serves not only as a proof of what has been related above, but has given the hint to physicians, of using sometimes one part of a plant, and sometimes another, as the case of their patient required: the root is serviceable in some cases, the bark in others, and the wood in others; the flowers, fruit, and the naked seeds, have all their several distinct virtues.

Remarks concerning the generation of plants, with some conjectures relating to the assisting of vegetation by honey.

To Mr BRADLEY.

SIR,

As it was your *New Improvements of Gardening* that gave me the first hint concerning the generation of plants, I shall take this opportunity of acquainting you with the experiment I have made upon that subject.

It is now about two years since I saved a large piece of spinage for seed; and, according to the old way of gardening, as soon as the male-plants began to shew themselves, I caused them to be plucked up, in order to give way to the she-spinage, as the gardeners call it, that the seed might ripen better; not considering that nature had ordained the one to assist the other. Some of my friends that saw the spinage growing, desired me to let them have some, I promised I would; and as soon as I thought the seed ripe, I caused it to be plucked up dry. As it was a pulling up, I found there

there had been some male-plants left, which might be sufficient to impregnate some of the female ones, but that was not the case. However I never considered of this till some time after that I sent some seed to my friends, who all sowed it, except one gentleman, that kept some by him, and sowed the rest. In a little time after I heard a great complaint, that my spinage-seed did not grow. Some thought that I had imposed old seed on them, but I assured them I had not: and my friend who kept some of the seed by him, when he found that half his seed did not grow, told me it had been eat by mice, but I assured him it had not: then coming home I examined that seed which I had left by me, and found that half of it had not got the punctum vitæ, which put me on considering how it should come to pass. But the reading of your *System on the Generation of Plants*, gave me a clear insight how it happened, it being for want of male-plants enough to impregnate and give life to the seed; since which time I always take care to leave enough of the male-plants, and in case I have always good success (f).

This

(f) The generation of plants bears a near analogy to that of some animals, especially such as want local motion, as oysters and some other shell-fish. The flower is the container of the parts of generation, and each performs its peculiar office for the propagation of the species. The flower of a lilly, for instance, consists of six petals, or flower leaves, from the bottom of which, at the middle arises a kind of tube, called the pistil, and round this there are disposed several small threads called the stamina, or chives, which arise also from the bottom of the flower, and terminate at their tops in small bodies called the apices, which contain a fine dust called the farina. This is the general structure of flowers, and though in many, some of these parts seem wanting; yet probably they are there, only less apparent. The fruit is usually at the basis of the pistil, so that when the pistil falls with the rest of the flower, the fruit is seen in the place of it, though in some this is not the case, but the pistil itself becomes the fruit. The petals seem only an outer covering to defend

This put me on trying experiments, in pulling out the apices in flowers before they had cast their dust. I told some of my friends of this system, but they would

defend the pistil and stamina, and the dust which the apices at the ends of these are full of, was by many great men believed to be only an excrementitious matter separated from the plant, by the chives, which they supposed tubes destined to carry off this abundant nutriment from the fruit. Later discoveries however have shewn this to be a very essential part of the flower, and to serve the office of the male sperm of animals, and that the pistil is properly the female organ of generation. The seeds which come up in their proper involucre, seem of the nature of the unimpregnated eggs of animals; also that the farina seminalis, or dust contained in the apices, is a congeries of plantules, each of which is to be lodged in one of those seeds, which are only a proper matrix for its reception; that the style or upper part of the pistil is a tube destined to convey these seminal plants into the uterus, or bottom of the pistil, where these seeds are lodged; and finally it appears, that the vast quantity of this farina is only because of the multitudes that must miscarry, for one that finds its way into this narrow passage.

To exemplify these conjectures by observation. It may be seen that in the crown imperial, the uterus, or vasculum seminale of the plant, stands upon the center of the flower; and from the top of this arises the style, the vasculum seminale and style together making the pistil. Round this are placed six stamina, the apices of which are so artfully fixed, that they play about with every wind; and are in height almost equal to the style, round about which they are continually in motion, and which in this plant is manifestly open at the top, and hollow all the way down; and to this it must be added, that on the top of this style there is a tuft of pinguiculi villi, or small tendrills, which seem destined to catch hold of the farina, or male dust, as it is dislodged from the apices when they burst, and from these it may very easily find its way through the hollow to the seeds it is destined to impregnate. The tube or style of the pistil always dies away as soon as the apices have discharged all their powder, having then served the purposes it was designed for. The seminal plant is always lodged in that part of the seed which lies nearest the

would not believe me, and only said that they themselves would try the experiment; then to my great astonishment we had some seed that ripened very well, and that, having all the good properties which it should have, after being sown, grew exceeding well. Upon this my friends told me that I had asserted a mere fiction; however I desired them to wait till I had tried it again. Accordingly I planted a dozen of tulips by themselves,

the aperture of the tube, through which this farina is conveyed; and in beans there is an evident perforation to be discovered by ordinary glasses just above the eye, which probably has been the passage by which the plantula seminalis entered. In these and the other leguminous plants also, if we carefully take off the petals of the flower, we shall discover the pod closely covered by an enveloping membrane, which near the top separates into several stamina, each loaded with its apex and farina, and these stamina are all bound closely to that brush which shews itself at the end of the pod. In roses there stands in the middle a column consisting of many tubes, which though closely clung together, yet are easily separable, and each leads to its particular cell, the stamina being in great abundance placed all round the orifices of these tubes. In strawberries and raspberries, the hairs growing on the outsides of those fruit are so many tubes leading to the seeds, and in the first opening of the flowers of these plants, these hairs stand in a thick wood as it were at the bottom of the flower, and are every where surrounded by stamina with apices on their tops; and it is not till after these apices have discharged their farina, that the fruit swells out of the husk. In flowers which naturally hang down, as the imperial crown and the like, the pistil is much longer than the stamina, that it may receive the farina as it falls from the apices.

Mr *Geoffroy* observed, that the cutting off the pistil of a flower before the apices were ripe, always made the fruit abortive, and the plant barren for that season. In some plants, whether male and female flowers stand on different stalks from the same root, or on different plants of the same species, the wind is the vehicle of this farina; and if it does not reach the female flowers, they ever remain barren *. *Miller.*

* See this system of the Sexualists controverted in note (a) of this Introduction.

selves, and as soon as they opened, took out the apices with a fine pair of nippers, lest I should shake some of the dust off; and by my microscope I could not discern any dust that had been left behind. About two days after, as I was sitting in my garden, I perceived, in a bed of tulips near me, some bees very busy in the middle of the flowers; and viewing them, I saw them come out with their legs and belly loaded with dust, and one of them flew upon a tulip that I had castrated: upon this I took my microscope, and examining the tulip he flew upon, found he had left dust enough to impregnate the tulip; which when I told my friends, they concluded that their flowers might be served so, by which means I reconciled them to this system. But it being probable that some people abroad may fall into the same mistake, and so condemn this hypothesis, I desire you will publish this; for there must be provision made to keep out insects, because plants may be impregnated by such as are much smaller than bees: the Creator of all things, in his infinite wisdom, appointed this way of generation to vegetables, which are incapable of any motion towards each other, therefore it may be supposed, that He had so ordained it, that a small part of the male dust should be sufficient to perform that office.

Yours, &c. PHILIP MILLER.

Concerning the generation of plants, it is observable in support of this opinion, that the orange-tree has male and female blossoms; the male blossoms having only the stamina and apices, with their dust, and the female ones a large divided pistil. Further, may be added the case of the hermaphrodite-orange, where we find upon the same tree compleat oranges, compleat lemons, and sometimes half an orange joined to half a lemon, and the orange and lemon-fruit quartered regularly: to this we may likewise add the *Switzerland*-grape, which in some parts bears bunches of black

black grapes, in others white grapes, and in others some bunches of half black and half white grapes; and what is still more extraordinary, in many places there are single grapes striped with black and white, which Mr *Fairchild* supposes could in neither of these cases happen by grafting; so then the grape I have mentioned seems to have been thus variegated in its fruit by the coupling of a white grape with a black grape.

The observation of insects carrying the male dust from flower to flower, and thereby impregnating some that would otherwise have never been prolific, is a thought entirely new, but at the same time seems reasonable; and Mr *Miller* is as right, in my judgment, concerning what he relates of the male spinage-plants, by whose dust nature surely designs to impregnate the seed in the female; and therefore it is an error to pull them up while there is any dust upon them, or till they have done their work.

We may observe from my papers in this treatise relating to bees, that the farina of the flowers is gathered by the bees to make their wax of; then it is hardly possible that they should shift themselves from flower to flower, without leaving here and there some of it in their progress; and though, in the flowers which Mr *Miller* castrated, the bees could not be invited to them, on account of the dust, for wax, yet we must consider, that these castrated flowers were not void of that excellent dew from whence they extract their honey; and so they visit all alike, and all may be rendered fruitful by their visits.

Of the cultivation of the fig-tree, in a letter to J. C. Esq;

SIR,

The last time I saw you I remember our conversation turned upon the cultivation of the fig-tree, a subject which has been very rarely touched upon by authors,

authors, and as rarely looked into by our gardeners; for figs, however excellent they are, have not yet so thoroughly gained upon the *English* palate as to be generally admired.

The reason perhaps may be, that only one or two of the most indifferent sorts has ever been common with us; or else that where some of the better kinds may have been planted, the want of skill in their management have either rendered them barren, or made them bring their young fruit at such seasons as our climate could not ripen them: but that all who are yet ignorant of the excellence of figs may have it in their power to be as much regaled with them as those gentlemen who have eaten them abroad, I shall communicate my thoughts of a figury or fig-plantation in this public manner.

To begin with the fruit itself. It has been supposed generally to bring no blossom, and therefore has excited the wonder of many ingenious men; neither the antients or moderns have accounted for this phenomenon, till Monsieur *Geoffroy* took it in hand; and his undertaking has shewn him to be no less curious in his inquiry than happy in his judgment. Upon the foot of the discovery of the generation of plants, he has, with a great deal of good reason, consulted the nature of the fig; he has examined the fruit at different seasons, and at different stages of growth, till at length he discovered the clue to that dark passage in nature, and has unravelled the mystery.

The fruit of the fig, he observes, is not only a nest of a multitude of small fruit disposed within side of the skin, but every seed or fruit therein has all its female parts of generation, as much as if it were a capital flower; and every one of these is so placed, that the hollow in the center of the fruit is large enough to permit every one to receive the farina fecundans, which may be flung upon them by the apices or male parts, that

that lie in the upper part of the fruit; and he has exactly marked out to us those parts which do the office of petals or flower-leaves above the apices, to preserve them from the weather; and has joined a very accurate cut of all the parts of this fruit, done with a microscope, at the end of a memoir he delivered before the Royal Academy of *Paris*.

There are not less than forty kinds of figs in *Europe*, which are in their turns counted valuable, and many of them are so forward naturally in ripening, or may be made so by culture, that it is possible to bring a great many sorts of them to perfection with us in *England*.

The way of planting them is early in the spring, without letting them be long out of the ground; because their roots soon dry, and then the parts languish: yet the driest rubbish ground or else a downright gravelly one, is that where this sort of fruit always does best. When I have a mind to propagate a fig, I draw a young branch through a pot, as I do the young shoots of the vines, and cut them off when a summer is past, and from the pots transplant them with the earth about their roots in places agreeable to their constitution; those which come from the hotter climates, in the warmest parts of the garden, and the rest in proportion to the climates they come from; for vegetables must have their own way, if we expect them to answer our designs, as well as animals, or else we have no profit from either.

The forward sorts of figs may be planted in the natural ground, and being left at liberty will bear well; but the late sorts must be forced, by nailing against walls, to gain us any fruit at all: in this last case especially, the method of pruning should be considered, and I know not any so agreeable to reason as what I have observed practised by Mr *Groening*. About the end of *July* he tops the branches of his fig-trees, and thereby not only prevents the autumn-fruit coming forward
against

against the winter-season, but prepares his trees to make good shoots in the spring, which bring their summer-fruit with them (g).

I am, SIR, Your most humble servant,

R. BRADLEY.

(g) There are some different species * of this tree cultivated in the gardens of *England*, but many more in those of *France* and *Italy*, where the fruit is in very high esteem, as it is also with the nicer palates here; though so much out of favour with the vulgar, that it stands safe on trees planted in places so exposed, that every other species of fruit would be stripped by robbers. One great discouragement to their more frequent propagation in *England*, is the unskilfulness of the generality of our gardeners in their culture and management. To obviate which, it may not be amiss to say somewhat in general here, of the proper management of this tree:

The common method has been to propagate these trees by suckers from the roots of the old ones, but they are much more successfully raised from cuttings. The branches may be laid down in *February*, and by the *February* of the following year, they will be fit to remove. This is the proper season to transplant them; and the best soil is such as has a gravelly, chalkey, or stony bottom, with a light surface; the tree will seem to flourish indeed more in a better soil, but in this poor one it will produce the finest and most plentiful fruit. They should always be planted in a free open situation, not shaded by trees or buildings, and will never ripen their fruit well unless against a good south, south-east or south-west wall. They should be planted at twenty feet distance, and the height for the wall they stand against, is about fourteen feet; the middle spaces between the trees, may be planted with vines to fill up the vacant part of the wall till the figs are grown, and then these should be taken up. In the summer, as the branches shoot, they must be trained horizontally against the walls, and no fore-right shoots should be suffered to come, but the buds of such should be rubbed off as fast as they appear. At *Michaelmas* they should be always pruned and nailed up. The great care to be had in pruning the old trees, is always to have a supply of young branches, for it is those only which

* See the next Chapter.

T

produce

CHAP. I. Concerning the native places of the several tribes of fruit trees; and the latitudes of the countries from which each kind was brought; with further observations concerning the culture of the fig, and a description of the best sorts, &c.

I Shall begin with cherries, which were not known in Europe till *Lucullus* had overcome *Mithridates*, King of *Pontus*, in the year of *Rome* 683, at which time *Lucullus* first brought them from *Pontus* into *Italy*; but they were not till an hundred years afterwards brought into *Britain*; as the ingenious *Sir William Temple* observes in his writings. This *Pontus* is a province in *Asia Minor*, between *Bithynia* and *Paphlagonia*, thus called because it lies along the *Euxine*-sea, whose capital city was *Heraclea*. Mr *Vernon*, a person of extraordinary curiosity in these matters, gives an account in a letter which he sent from that part of the world, that near the *Black Sea*, there was a town named *Cberefium*

produce fruit. None of the shoots of the former autumn pruning must be shortened, for it is on the two year old wood, that the fruit is produced; the young branches must be always brought very close to the wall, and this will screen them from injuries by frosts, and much forward the early ripening of their fruit. The old branches should never be laid in too thick, which is a great fault among most gardeners; the distance ought to be at least a foot between branch and branch, and as the young ones grow strong, the old ones should be always cut away. In *April* or the beginning of *May*, several of the leading shoots should be stopped, which makes them throw out side branches. In very hard weather the trees should be covered with straw, peas halm or the like; and that not to be removed till the weather is milder, and then not all at once, but only by a little at a time. The higher the wood runs up the wall, usually so much the better tasted is the fruit; and no trees succeed better in fruiting, than those which are nailed up against chimnies, where, beside the height, they have some advantage from the heat. *Miller*.

Cherestum or *Chirestum*, about which cherry-trees grew wild; and he supposes they might take their name from thence; its latitude is about 43° north, which is about $8^{\circ} 30'$ more south than *London*, where cherries grow very well without shelter; or even as far or farther north than *Edinburgh* they are cultivated with good success, though the latitude of *Edinburgh* is $56^{\circ} 5'$; so that here is one instance of plants which will bear with a change of climate for about thirteen degrees.

In the next place it is observed by Sir *William Temple*, that after the conquest of *Africk*, *Greece*, the *Lesser Asia* and *Syria*, there were brought into *Italy* all the various sorts of *mala*, which we interpret apples, and might signify no more at first.

The apricots, coming from *Epirus*, were called *mala epirotica*. The peaches, from *Persia*, *mala persica*. Citrons from *Media*, *mala medica*. Pomgranates from *Carthage*, *mala punica*. Quinces, from a little island in the *Grecian* sea, *mala cathonea*. Their best pears were brought from *Alexandria*, *Numidia*, *Greece* and *Numantia*, as appears by their several appellations. Their plumbs from *Armenia* and *Syria*, but chiefly from *Damascus*.

But let us examine now the climates the several fruits came from, that we may the better know how to place them in our gardens. We shall begin with the *mala epirotica* or apricot, which was brought from *Epire*, a province of *Greece*, separated from *Macedon* by the river *Calydnus* and mount *Pindus*; the chief cities were *Lerta*, *Bestia*, *Preveza*, &c. there the apricot grew or was esteemed natural, about 40° N. Lat. being 3° more south than the cherry.

The *mala persica*, by which is meant the peaches, have their name from *Persia*, but that is so general, that we know not where to fix our point; for *Persia* extends itself from about 30 to 40 degrees N. Lat. then let us take the medium of that, which is about 35° N. Lat.: but it appears that their early sorts grow

in places near the *Caspian* sea, 5° farther north; and our latest peaches might come from those parts nigh the *Persian* gulph, which lies above 5° more south than the middle of *Persia*: so that there is 10° difference of latitude throughout *Persia*, the peach-country. The difference however, according to the points I take, *viz.* *London* and the middle of *Persia*, is above 16° ; or if we add 5° more south, and suppose peaches to come from about the *Persian* gulph, then the difference between *London* and the peach-country is more than 21° . It is certain, that in *Italy* peach-trees do grow to sixteen or eighteen feet high in two or three years after planting, without walls, which shews that they love heat; and our best walls in *England* will not constantly ripen all the sorts: however, our catalogue of peaches furnishes us with so many various kinds, that we have some or other from *June* to *November*, and I therefore fancy their different times of ripening happen from the difference of the climates they were brought from: for every vegetable that I know of will, if possible, preserve its natural time of spring and growth, whatever climate it comes from, or is in; if it comes from under the line to us, it will aim at shooting in its own season, if we can but keep it alive. But I shall shew these differences of latitude more plainly in this chapter by a table.

Next the pomgranate, or mala punica, is a fruit which was brought into *Italy* from *Carthage* near *Tunis*, whose latitude is 33° north; it is to be supposed, that this tree, as it was brought from *Africa*, might have its original place more south than *Tunis*, though it would live there; for I find it very difficult to ripen its fruit with us. Some indeed have been barely ripe in *England*, and several have produced fruit as large as golden rennets; but they often failed of ripening. I have some reason to believe from what I have observed at *Paris*, that the dwarf sort would do much better with us: because it is so generous to blossom when

when it is not ten inches high; and upon one plant which I had presented me of that sort, there were three fruit, though it was not quite a foot high: they take little room, and little care; and I suppose will bear fruit very readily with us, because they blossom much earlier than the great sort; and that they will live in *England* without shelter, there is no doubt, if they are brought no farther from the south than the coast of *Barbary*. It is observable in the *French* King's garden at *Paris*, that they bear without difficulty in little pots, but they are there sheltered in the winter; and I suppose the reason of that is, because in this country the winters are much more severe than they are in *England*; being so pinching cold as to destroy their vines, their olives and pomgranates: though their summers are so violent hot, that their fruits ripen much better than ours do. Thus, though we have not the severities of their winters, we want the heat of their summers to bring some fruits to perfection.

This fruit bears and ripens very well in *Italy*, but does not like the northern parts of *France*; so that we have but few instances of tolerable ripe pomgranates in *England*. Yet to bring such trees constantly to furnish our tables, I think it would be necessary to find some way to make them spring about two months before their usual time (a).

We

(a) The pomgranate tree may be easily propagated by laying down the branches in the spring, which in one year's time will take good root, and may then be transplanted where it is designed to remain. The best season for transplanting these trees is in spring, just before they begin to shoot; they should have a strong rich soil, in which they flower much better and produce much more fruit than if planted on a dry poor earth.

The flowers of this tree always proceed from the extremity of the branches which were produced the same year: this therefore directs, that all weak branches of the former year

We come now to the *mala cathonca* or quinces, which are said to be brought from an island in the *Archipelago* about 37° N. Lat.; this fruit grows pretty well with us, but ripens late; I have not heard of any who have tried it against a wall, where perhaps it might be mended, at least improved by my new proposition for ripening fruit.

The next is the pear or *pyrus*, so called from the pyramidal form of its fruit; the best sorts of which the *Romans* brought from *Alexandria*, *Greece*, and the country thereabouts: if we have any of the same sort now among us, I should be apt to think that the latter kinds were brought from the most southern places; *Greece* lying between 38 and 40° N. Lat. and *Alexandria* about 30° .

Plumbs were brought first to *Italy* from *Armenia* and *Syria*, but chiefly from *Damascus*. *Armenia* lies about the latitude of forty-two, *Syria* about thirty-five, and *Damascus*, once the capital town of *Syria*, was situated in 35° N. Lat.

The *mala medica*, i.e. citrons, according to the best authors, were so called because brought from *Media*, an antient kingdom in *Asia*, into *Italy*, lying about 40° N. Lat.

To conclude, I shall exhibit the table I promised; because I think there is no room to doubt but that the several parts of *Europe* were furnished with the fruits I mention, from *Italy*, as has been observed before: and it is highly probable, that the *Romans* furnished themselves with them from the places which we have named.

Latitude

should be cut out, and that the stronger should be shortened in proportion to their strength, in order to obtain new shoots in every part of the tree.

Though the fruit of this tree seldom arrives to any perfection in this country so as to render it valuable, yet for the beauty of its scarlet-coloured flowers, together with the variety of its fruit, there should be one tree planted in every garden, since the culture is not great which they require. *Miller.*

Latitude of London.	English names of fruit.	Roman names of fruit.	Names of the supposed native places of the several tribes of fruit.	Latitude of these places.	Number of Degrees these places are more South than London.
Lat. $51\frac{1}{2}$	Apricot.	Mala Epi-rotica.	Epirus in Greece.	About 40 Deg. N.	$11\frac{1}{2}$
Lat. $51\frac{1}{2}$	Peach.	Mala Per-sica.	About the middle of Persia.	About 35 Deg. N.	$16\frac{1}{2}$
Lat. $51\frac{1}{2}$	Pomgra-nate.	Mala Pu-nica.	Carthage, about 1 unit, in Africa.	About 33 Deg. N.	$18\frac{1}{2}$
Lat. $51\frac{1}{2}$	Pear.	Pirus, or Pyrus.	Alexandria. Greece.	About 30 Deg. N. About 40 Deg. N.	$21\frac{1}{2}$ $11\frac{1}{2}$
Lat. $51\frac{1}{2}$	Plumb.	Prunus, or Prunum.	Armenia in Asia. the middle of Syria in Asia.	42 Deg. N. About 34 Deg. N.	$9\frac{1}{2}$ $17\frac{1}{2}$
Lat. $51\frac{1}{2}$	Citron.	Mala Me-dica.	Damascus. Media in Asia.	About 35 Deg. N. About 40 Deg. N.	$16\frac{1}{2}$ $11\frac{1}{2}$
Lat. $51\frac{1}{2}$	Quince.	Mala Ca-thonea.	An island so called in the Archipelago.	About 37 Deg. N.	$14\frac{1}{2}$
Lat. $51\frac{1}{2}$	Cherry.	Cerasus.	Pontus by the Euxine sea.	About 40 Deg. N.	$11\frac{1}{2}$

I shall now offer some observations of a very curious person in *France*, who had long applied himself to the study of fruit-trees, and had gained knowledge enough thereby to give us not only the names of the several distinct kinds, but such descriptions of the several sorts as may point out to us their mode of growth, their shape, their time of ripening, and their qualities; he has so exactly described the perfections of every sort, that from his remarks any one may easily know every sort of good fruit, and when in perfection.

The author, whom I shall present to my reader, writes himself *John Merlet*, Esq; a person well known at *Paris* for his great judgment in fruit-trees, and long experience of them. And as near as possible, I shall give my readers his own words concerning the fruits known to him and mentioned by him.

To begin then with our author; he introduces his discourse thus. I would not have undertaken to write about the culture of trees, or the several species of fruits; but that, among the many books which have gone abroad, I observe there is not one author that points out to us which kind of trees are most to be admired, or worthy our care. Those papers which have been printed, have treated in general of fruits, without telling us which are the best or worst. Their catalogues of fruit are full of names, but their names do not distinguish their perfections: gentlemen therefore, for the most part, who have cultivated plants from these lists, either in espaliers or dwarfs, have rather stocked themselves with vast varieties, than considered the goodness of the fruit they planted; or as it often has happened, the same fruit under different names has been cultivated in two or three places in the same garden. This obliges me to abridge the common catalogue, and preserve only the names of such fruits as are good with us, and to give their synonyms, and describe their several remarkable differences;

rences; and moreover to mention such, as have not yet been treated of by any author, or whose time of ripening or perfection has not been justly observed; without which, fruits are useless.

After this, Mr *Merlet*, goes on to give us the names and descriptions of the several sorts of fruits which are most in esteem; not troubling himself with the characters of those which are indifferent. And as the reader takes a survey of his performance, he must remember, that about *Paris*, the summers are much hotter than with us, and the winters much colder; and that the late fruits which he treats of in espaliers should be in our climate rather planted against walls.

I shall here begin with his observations upon the fig-tree, which is in a manner a stranger to us.

The fig-tree does not bud or shoot till after all severe weather is past: its fruit is delicious, and there are many kinds of it. The first or most early fig, is the white fig, called in *French*, *figue fleur*; or in *English*, the fig-flower, or flower of figs; of this there are three sorts: first, the large, with a short stalk a little flat. 2. The large with a long stalk. 3. The little *Marseilles*-fig, which is flat, and is a very great bearer.

These three kinds are all white without and within the fruit, they are richly sugared and melting, have few seeds, and bear twice a year, in the spring, and in autumn. Of these there are some sorts better and more rare than others; some larger and more melting, and some smaller in fruit, and of lesser seeds.

4. Next to these is the yellow fig, or as it is called in *French* the angelique, or incarnadine; which we may interpret, the angelic fig, or incarnation fig; because of its reddish colour within-side like the pomegranate: it brings a large fruit like the former, which we call the fig-flower; it is given to shoot much, and bears little in the spring, but in *September* brings fruit in

in abundance, which are rather better tasted than the spring-fruit, and ripen kindly.

5. The golden or gilded fig, or in *French*, figue dorée, is large and flat; it brings a good second crop of fruit, much better in autumn than in summer; this fig is called by some la gueuse or begger, because its skin tears and cracks when the fruit ripens.

6. The flat violet-fig, or in *French* figue violette plat, has its fruit of a middling size, and brings little in its summer crop; these are supposed to be the blossoms of figs, because of their appearance upon the wood of the preceding year: but upon the motion of the second sap, or the young shoots towards the end of the summer, it bears plentifully: it is melting, and may be ranked among the best of figs.

7. The long violet-fig, or in *French* figue violette longue, is very large; it is named by some of the *French* gardeners figuepoire, or pear-fig; and likewise figue de bourdeaux: this is a great bearer in both seasons, but hardly ripens its autumn-fruit; it is of less esteem than the former, being full of large seeds, which renders its pulp drier than the preceding sort; besides, its flavour is too rank; but it is necessary to have some of them, because they ripen in *September*, between the first and second crops of white figs.

8. The green fig, or in *French*, figue verte; in *Italian*, verdone; is called likewise by some of the *French* gardeners, la verdalle, or figue d'Espagne, or spanish-fig; this fruit is almost round, always of a green-colour, though it be full ripe, and very red within-side; it bears little in its first crop; but the second, that is to say, in *September* and *October*, it brings plenty of fruit; it is one of the best sorts. Its wood is less subject to freeze than that of other fig-trees, except that which the *French* call la figue d'autonne, or la figue celeste; which in *English* may be rendered the autumn-fig, or celestial fig; whose fruit stands the

the winter, and ripens in the spring, for which reason some call it *figue d'hyver*, or winter-fig.

The green-fig, mentioned above, does very well in *England* without much care, as I have experienced.

10. The melinga-fig, or *figue de melingue*, is of a violet-colour, it is very long and thin, and red within, and very delicious; it requires the best exposure, and is very apt to run and drop its fruit when it is near ripe; and it is difficult to make it bear for some years after it is planted.

11. The bruceotte, a fig so called by the *French* and *Italians*, is pretty large, flat, and of a violet-colour; it is red within, very well tasted, and bears extremely well in autumn.

12. The dwarf fig-tree, or in *French* *figuier nain*, brings short shoots with buds very close set; it bears plentifully, and its fruit is of a violet-colour, and red within: they are of a pretty large size.

13. The bouriageotte fig is larger than the former, and of a rounder make; its colour is not so deep a violet; its stalk very long and thick; it bears as little as the others about *St John's-tide*, but brings plenty of fruit in *September*; it is a good fruit, although its seeds are large.

14. The little mignionne-fig, or in *French*, *petite figue mignionne*, is not much larger than a cherry, and is of a brownish violet-colour, and very red within; it is very well tasted, and brings a great deal of fruit.

15. The madeira-fig, or in *French*, *la figue de madeire*, is the black, large, long fig; it produces good store of fruit, but they ripen with difficulty about *Paris*: it requires abundance of sun, and a very high wall.

16. The grey fig, or in *French*, *la figue grise*, is greyish on one side, turning a little towards the violet-colour: it is long and pretty large, and is well enough esteemed.

16. The

16. The *Genoa* fig, or in *French*, *figue de gennes*; called likewise by some *French* gardeners *l'aubicon*, or *la figue fievre*, or *fever-fig*, brings the largest fruit of any other: It is long and of a brownish purple-colour, is shaped somewhat like a *bon chretien* pear, and is of an excellent taste. The leaves are of an extraordinary bigness; this sort brings plenty of fruit in its second crop, and very few in the first: at *Genoa* excellent dried sweet-meats are made of this fruit.

17. The fig named *vernifingue*, is almost round and of a brownish purple, and is esteemed one of the best sorts; it delights in much sun, like the rest, which bring their fruit in autumn.

I could yet mention a great variety of figs, but these are what I account the best; and my design is only to speak of such fruits as are worthy our care, and to reject those which have hitherto crouded our catalogues to no purpose.

The best or warmest exposure will much meliorate them; not but most of them will do well almost on any wall, though the fruit may come somewhat later; for a dry warm air will ripen them.

The fig-tree thrives better in dry than in wet ground, and hates the knife; for the first figs always come upon the extream parts of the branches of the preceding year: but it is good however, to pinch off the top-buds of the young branches of the same year in *June*, because it stops the too free course of the sap, and brings the tree to bear fruit much earlier in both its crops.

If a wall fig-tree happens to be too full of wood, we may about the beginning of *July*, take out some of the great branches, and immediately apply some of the prepared mixture warm with a brush to the wound. *Note*, The mixture made up is of bees-wax, rosin and turpentine.

Fig-trees

Fig-trees should be transplanted in *March* or *April*, when the frosts are over; for frost is a great enemy to them; which obliges us to cover many sorts in the winter, and even to plant some in cases, to be housed with our orange-trees; when they are in full sap, they must be well watered, of which they then drink a vast quantity.

It is also to be observed, that fig-trees which require walls, will not be constrained like other wall or espalier-fruit, but must have a great share of liberty; they cannot prosper or bring good fruit if they are confined; we may indeed fasten the great stems to the wall, but it is necessary to let the young shoots which bear the fruit, be free and enjoy the air; the fruit will ripen better.

The fig-tree may be inoculated with much better success than grafted in the cleft, but there must be great care taken to preserve the buds when they have taken; during the severity of the winter we may cover them with straw. The safest way is to inoculate about the bottom of the tree near the root, which part is less subject to freeze than the extream parts. And when it happens that the fig-trees are so injured by frosts, that some of their branches are lost, we must not cut out the dead wood till the midsummer following: the fig may likewise be grafted in the stock or the bark, and the best and surest way is by approach; I have likewise grafted in the cleft, which has taken very well.

The fig-tree does not love culture as most other fruit-trees do, it covets none at all, or very little; for it is a certain rule, that the more we dig about it, the less fruit we have from it, and it runs all into wood, it delights in stony ground without any culture; the wood of the fig is close set with buds, which yearly produce fruit; the sap of this tree is too vigorous to want any help or any enrichment, but rather is kept to bearing by laying sand at the root, which helps to bring

bring the fruit forward: the ashes of lye or buck-ashes are extremely good to lay at the roots of fig-trees, and have an admirable effect: they kill weeds, warm the earth, and set the tree to bearing plentifully that fruit which is the favourite of our gardens (b).

CHAP. II. *Of vines, their culture and management, according to the practice of the greatest virtuoso's in France: with the names and descriptions of all the best kinds of grapes; and the manner of improving old decayed vines.*

I Shall introduce these papers with some curious observations concerning the culture of vines, as now practised by the most ingenious in *France*, and put into my hands by a person of honour.

The vine is raised either by layers or cuttings, but the layer is much the surer and best way. The layers should be made of branches or shoots of two feet long at least, which should be all buried in the earth excepting two buds only; but if it was three feet long, it would be much the better and make stronger shoots. The layers should never be nearer one another than a foot and an half, but the cuttings should be three or four feet apart if we plant them for standing. When they are once thus disposed, we must be sure to dress them three times every year, stirring the ground gently about them: the first time is early in the spring, just after the vines are pruned, which is done with an hoe; the second is also done with an hoe in *June*; and the third in *August* with the same instrument. In *France*, the first of these operations is called *houer*, the second *biner*, and the third *tiercer*; but some vine-dressers neglect this last work, though I think it as necessary

(b) See the Introduction to this second Part.

as the others to nourish and enlarge the fruit, and strengthen the wood: some will do this after the vintage, but it has not then the good effect we desire; all that can be expected from such late opening the ground is the destruction of weeds, which perhaps rob the vines of some nourishment.

The second year we prune the vines, leaving only the strongest shoot shortened to three buds.

The third year we must disbud our vines, so as to leave only two strong shoots, which the following year must be pruned, viz. the lower shoot, which is next the earth, must be left with three buds only, but the uppermost may be pruned to five or six buds, and then set up by props or stakes.

The disbudding I speak of, I account very necessary, because a vine is little wounded by it, and the shoots which come forward are strong and bring good fruit; but without this method our vines are either too much wounded, or are too full of wood, to bear or ripen their fruit well in a vineyard.

The fourth year it is necessary to clear the old wood of its black strings, or rough loose bark, and refresh the earth about the root in fair weather if possible, without frost, snow, or thaw; and when the vine is strong, we may leave two runners, one bearing branch, and one layer: in extraordinary cases we may leave two or three of the latter, but this depends upon the skill of the vine-dresser; we may leave more or less wood or buds, as the vine is more or less strong.

In a full vineyard the layers must be taken up every year at the pruning season, when it is also a proper time to lay down others; the layers made in winter are apt to shoot into wood, and those laid down in spring are more subject to bear, and run less into wood.

It is a rule in *France* to prune young vines, that is, during the three first years, at the new moon; but when they come to bear, they choose the decrease, in

February

February or *March*; and in this last case, it is to be observed, that the top-bud must be left at the back of the slope in the cut, lest the vine, which is subject to bleed by such late pruning, should drop so much upon it as to rot the bud: and likewise great care should be taken lest the buds be cut or wounded upon the shoots that are pruned.

To bring grapes forward, we may plant them against walls; but I think it is not adviseable to plant them among peaches or other fruits, but against a wall by themselves; for their vigorous shootings are apt to over-grow, and smother the trees that grow near them.

If we cultivate any of the muscat-grapes, we should not use dung about the roots; for though they will make vigorous shoots by that dressing, they will not bear well, and the grape will ripen late, and have little taste; but when the soil is dry and poor, the fruit is well relished, ripens sooner, and lasts longer.

It is an observation about *Paris*, that when we plant vines against walls, they should be exposed to the east sun rather than to the west: I speak this of such vines as are brought from the warmer climates and ripen late; for in this exposure I find the fruit is better, and ripens earlier than the same sorts will do against a south wall; for the violent heat of the south sun and the wall together hardens the skin of the grape, and though it is sooner coloured, yet are its juices less mature or agreeable.

In the pruning of late bearing vines, we should observe that we do that work as soon as the fruit is gathered; this will occasion the sap to move early in the spring, and bring the vine to blossom earlier than ordinary, which consequently disposes the fruit to ripen soon; but if we prune these late grapes in the spring, the fruit will come late, and be good for nothing.

To

To gain time in bringing forward any curious sort of grape, we may graft a vine in the cleft; and for this purpose we must choose our stock at the root of some strong vine, and cut it into the ground three or four inches, and therein fix our cion, which will presently strike: the best stocks I account for this use are the muscat-grapes, whose juice is sweet and high flavoured; and the proper season for the work is about the beginning of *April*.

When the foot of the vine is large, we may put in two cions side by side: but when it is young and pithy, we must place our graft in the stock, as we graft a jessamine: such grafts will come to bearing the second year.

To raise vines from cuttings, I have saved a great deal of time by setting the cuttings in baskets of a proper mould, and putting them in hot-beds, always observing to prune the bottom of the cuttings just below a bud; by this means I have had very large vines in one summer, and about autumn have planted them with their baskets in the places where I designed them to remain: if they were late sorts, I pruned them sometimes, which occasioned the fruit to ripen before the autumn-fogs could injure it (a).

The

(a) All the sorts of vines are propagated either from layers or cuttings. The former is the method usually practised with us, but the latter seems much the better.

In order to propagate them by cuttings; these must be chosen such as are strong and well-ripened shoots, of the last year's growth; and these should be cut from the old vine, just below the place where they were produced, taking a knot of the two years wood, which should be pruned smooth. The upper part of the shoot should then be cut off, so as to leave the cutting about sixteen inches long. These cuttings are to be placed with their lower part in the ground, in a dry place, laying some litter about their roots to prevent them from drying. In this place they should remain till the beginning of *April*, which is the time to plant them. They are then to

The grapes which are most esteemed in *France* are,
 1. The *precox*, or *morillon hativeau*, *i. e.* the early
morillon, and by some called *vigne de la magdelaine*,
i. e.

be taken up and wiped clean, and if they are very dry, they should stand with their lower parts in water six or eight hours. Then, having prepared the beds for them, they are to be set at about six feet distance from each other, making their heads slant a little towards the wall. The cutting is to be so buried in the ground, that only the uppermost bud be upon a level with the surface; the earth is then to be well closed about the plant, and a little mould heaped up over the eye of the bud, to keep it from drying. After this, there is no more trouble necessary, but to keep the ground clear from weeds, and to nail up the shoot as it grows, to the wall, rubbing off all the side-shoots.

The *Michaelmas* following, if the cuttings have produced strong shoots, they should be pruned down to two eyes. In the spring following the ground is carefully to be dug up about the shoots, and the stalks to be earthed up to the first eye. During the summer all the lateral shoots must be rubbed off as they appear, and only the two from the two eyes which were left, must be encouraged; these, as they grow, are to be nailed up against the wall; and in the middle of *July* they should be shortened, by nipping off their tops, and this will greatly strengthen the shoot. At the *Michaelmas* following these should be pruned, leaving them each three eyes, if they are strong; but if they are weakly, only two. The next summer there will be two shoots from each shoot of the last year's wood; but if there should be two from one eye, which is sometimes the case, then the weaker is to be rubbed off. At midsummer the ends of the shoots are to be pinched off as before; all the weak lateral shoots are to be displaced, as in the preceeding summer, and the whole management is to be the same. This is all the culture necessary to young vines.

As to the management of grown vines, it is to be observed that these rarely produce any bearing shoots, from wood that is more than one year old; the great care must therefore be always to have plenty of this wood in every part of the tree.

The bearing shoots for the following year should be left at the pruning with four eyes each. The under one of these does not bear, and consequently there are only three which do.

i. e. the magdalen-grape, it is the earliest ripe, but is not so good as it is rare: the skin is thick, and is subject to be devoured by the flies: however we must not be without some vines of it, as it makes a dish at the table before other grapes are fit for eating.

2. Morillon taconné, or munier, *i. e.* the miller's grape, so called, because of its white powdered leaves:

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this

do. Many leave more eyes on the shoots, that they may have more fruit, which is the consequence; but then the fruit is much poorer; and this is so well known in the wine countries, that there are laws to direct that no more than such a number of eyes are to be left on each shoot, for the grapes would else be of a poor juice, and destroy the reputation of their wine. Each of the three eyes left, will produce two or three bunches; so that each shoot will give six or nine bunches, which is as much as it can bring to any perfection. These shoots must be laid in at about eighteen inches asunder on the wall; for if they are closer, when the side-shoots are produced, there will be no room to train them in upon the wall; and the largeness of the leaves of the vine requires also that the shoots should be at a proportionable distance.

The best season for pruning vines is the end of *September*, or beginning of *October*. The cut is always to be made just above the eye, and sloped backward from it, that if it bleed, the juice may not run upon the bud; and where there is an opportunity of cutting down some young shoots to two eyes, to produce vigorous shoots for the next year's bearing, it should always be done. In *May*, when the vines are shooting, they should be looked over, and all the shoots from the old wood should be rubbed off, as also the weaker, whenever there are two produced from one eye. During the month of *May* the branches must be nailed up against the wall as they shoot, and toward the latter end of this month, the ends of the bearing branches should be nipped off, which will greatly strengthen the fruit. Those, however, which are to bear the next year, should not be stopped before the beginning of *July*.

When the fruit is all gathered, the vines should be pruned; whereby the litter of their leaves is all removed at once, and the fruit will be forwarder for this the succeeding year.

Miller.

this sort is the second ripe, and is much better than the first; it makes excellent wine, and bears well.

3. Morillon noir ordinaire, *i. e.* the common black morillon, is a very sweet grape, fit for the table, and makes good wine. In *Burgundy* it is called pineau, and at *Orleans*, auverna.

4. Morillon blanc, *i. e.* the white morillon, is harder than the former.

5. Raisin de mantoue, *i. e.* the mantua-grape, is ripe about the beginning of *August*; its bunches are pretty large as well as its berry; its shape is rather long than round, and its colour like yellow amber, its juice is very rich.

6. Raisin d'autriche, ou feuille de persil, *i. e.* the austrian-grape, or parsley-leaved grape, called also ciouta, is a white sweet grape which bears pretty well: the fruit is somewhat like the chasselas, but its juice is not very vinous.

7. The chasselas or muscadet is an excellent grape, either for eating raw, drying, or making wine: its bunches are not very full of fruit.

8. Chasselas noir, *i. e.* the black chasselas, has most of the qualities of the former, but is not so common. There is also a red sort of chasselas, whose bunches are larger than the others; but neither of these are strongly coloured.

9. Muscat blanc de frontignan, *i. e.* the frontignean white muscat-grape, is a large long bunch, full of fruit; it is excellent for eating raw, or in sweetmeats; it makes good wine, and dries well, either in the oven or in the sun.

10. There is a kind of grape called muscat blanc de piedmont, *i. e.* the white piedmont muscat-grape; its bunch is long; it has smaller fruit than the former, and its pulp is more unctuous.

11. Muscat de ribezalte, is richly musked, its berries are small, and its juice sweet, and so agreeable, that

it

it would be one of our first grapes, if it was not apt to run; frequently degenerating to the curran-grape.

12. Muscat rouge, *i. e.* red muscat or muscadine, by some called muscat de corail, *i. e.* coral muscadine, from its beautiful colour; has the same qualities of the former, but its berries are firmer. It requires a good deal of sun to bring it to perfection; but it is then one of the best grapes.

13. Muscat noir, *i. e.* the black muscadine, is larger than the former; its bunches are very full of fruit, which is not so high tasted, though its juice is very sweet; it bears well, and ripens its fruit pretty forward.

14. Muscat violet, *i. e.* the violet-muscadine, is of a clearer black tending to a violet-colour; its bunch is very long, and its fruit large; it is richly musked, and one of the best grapes.

15. Malvoisie musquée, *i. e.* the malmsey muscadine, is one of the richest musked grapes, surpassing every other kind in high perfume. It comes from *Montserrat*, and grows plentifully about *Turin*.

16. Muscat long, *i. e.* the long muscadine, or *passie-musquée d'Italie*, *i. e.* the late Italian muscadine, makes excellent sweetmeats, or may be eaten raw: its bunches are very large and long, and it must be warmly exposed to ripen its fruit; but even though the season should not suffer it to be half ripe, it is much higher perfumed in sweetmeats than any other grape, the fire supplying that musked flavour which it was denied by the sun.

17. There is likewise a grape called muscat long violet, *i. e.* the blue long muscadine, and in some places the madeira-muscadine, which is a beautiful and excellent grape.

18. Raisin de corinthe, *i. e.* the curran-grape, or corinthian-grape, has a sweet juice; the bunch is narrow, and closely pressed together; it has seldom any seeds no more than the red curran-grape.

19. *Le corinthe violet*, *i. e.* the blue curran-grape, is a little larger than the former; is very good, and without seeds; it is very apt to run, and for that reason should be pruned longer than other vines.

20. *Raisin sans pepin*, *i. e.* the grape without kernels, is a kind of chasselas, but the bunch is not so large; it is a little sharp, however it is extremely good prepared in an oven, as it has no kernels; for which reason, some call it the curran-grape.

21. *Vigne greque*, *i. e.* the greek grape, by some called *St Jacques*, *i. e.* *St James's* grape, or *raisin merveilleux*, the miraculous grape, is a sort of red bourdelais, whose fruit is large and round; it comes early, has a pleasant sweet juice, and makes very good wine; its bunches have a fine appearance; and its leaves, when the fruit is ripe, are beautifully marked with red, which is pretty common in black, blue, or red grapes.

22. *Le jenetin*, or *jeneting* grape, by some called *muscat d'orleans*, *orleans muscadine*, or *raisin de St Menus*, is white, very sweet, and not unlike the *melicé*, but rather like the *malmsey* grape; it is apt to degenerate.

23. *La beaunie*, *i. e.* the *beaune* grape, is of a whitish colour, pretty good, bears well, and is so called, because it is very frequent, and much admired about *Beaune*.

24. *Le bourguignon*, is a black grape, pretty large; it is better for making wine than for eating; and is an extraordinary bearer.

25. *Le damas*, *i. e.* the *damask*-grape, is an extraordinary fruit; the bunches are very long and large, and the grapes bigger than ordinary: they are of an amber-colour, and have but one kernel in each; they are apt to run, and therefore should be pruned long; there is the white and the red of this sort.

26. *Raisin d'abricot*, *i. e.* the *apricot*-grape, is so called, because its fruit is yellow, and gilded like an apricot;

apricot; it is of that tribe which is distinguished by the denomination of bourdelais.

27. Melié blanc, *i. e.* the white melie grape, is a good grape for eating, and one of the best for the vintage; its juice is sweet, bears well, and will keep. This is one of the best for drying in the oven.

28. Melié noir, *i. e.* the black melie grape, is not so good as the former for eating, nor does it make so strong a wine.

29. Melié vert, *i. e.* the green melie, is very rare, bears well, and is not apt to run. The wine made of this grape never changes yellow.

30. Le sauvignon, is a black grape, large and long; it is early ripe, and is one of the best grapes.

31. Le sauvignon blanc, the white sort, has the same qualities with the former; that but of them are little known.

32. Le gamet, is of two sorts, the black and the white; it is an extraordinary bearer, and one may say the very best; but the wine made of it is small, and its plants last but a few years.

33. Bec d'oiseau, *i. e.* the bird's-bill grape, or piquant-paul, is called in *Italy*, pizutelli, that is to say pointed; the grape is large, very long, and pointed at both ends.

34. The blue pizutelli is called in *France* dent de loup, *i. e.* wolf's tooth; its grape is long, but less pointed than the former; it keeps well, and is a good tasted fruit, and very handsome to the eye.

35. Le gland, *i. e.* the acorn-grape, so called because the fruit is shaped like an acorn; it is very sweet, keeps well, and is of a yellow colour.

36. Raisin suisse, *i. e.* the switzerland grape, is rather rare than good. The clusters are large and long, and its fruit striped with black and white, and sometimes half one and half the other.

37. Gros noir d'Espagne, *i. e.* the great black spanish-grape, by some called vigne d'Alicant, or

the alicant-grape, brings large clusters, well furnished with large grapes fit for the table; from this grape is made the most excellent *Spanish* wine.

38. Le sanmoireau is a black grape excellent for eating and making of wine. This grape is longish, firm, and grows free upon the bunches.

39. The frementeau grape is of a reddish grey colour; its bunches pretty large, and its grapes or berries closely set together. The skin of this fruit is a little hard, but its juice excellent; it is of this grape that the excellent wine called fillery wine, or vin de fillery, is made.

40. Blanquet de lemois, is a white transparent grape, as clear as glass; the berry is long and pretty large; it bears well, and has an excellent rich juice.

41. La malvoisie, i. e. the malmsey-grape, is of a grey colour and bears well; its berry is small, but extremely rich and high flavoured: it ripens early, and is so full of juice, that I esteem it the most melting of all grapes.

42. Malvoisie rouge, i. e. the red malmsey-grape, is of a flame-colour, and has the same qualities with the former.

43. Malvoisie blanc, i. e. the white malmsey-grape, is a more rare, but a later grape than the other two. I esteem the grey sort to be the best.

44. Le maroquin, is a large blue grape, which brings bunches of an extraordinary size, and berries very large, round and hard; the wood is reddish, and the leaves veined with red. One sort of it bears in an extraordinary manner, and blossoms three times in a summer. The midsummer-fruit sometimes comes to perfection about *Paris*, but the third blossom comes to nothing: however in the south parts of *Italy* all the three crops ripen, for which reason it is called there uva de tre volti.

45. Raisin d'Italy, i. e. the Italian-grape, named by the *Italians* pergoliese, is of two kinds, viz. the white

white and the blue. The bunches are large and long, and the berry longish and freely disposed upon the bunches. It does not ripen kindly about *Paris*.

46. Raisin d'Afrique, *i. e.* the African-grape, is very large, its berries looking like plums; of this there are the red and the white; its bunches are of an extraordinary size; the figure of its grape rather long than round, a little flat towards the point; its wood and leaf are remarkably big, and it requires a great deal of sun.

47. Le furin, is a vine highly esteemed in *Auvergne*; it is one of the melié tribe, well tasted, and its fruit a little pointed.

48. The bourdelais is of three kinds, the white, the red, and the black, the bunches of fruit are very large, rather fit to make verjuice or sweetmeats than for eating. This vine is the best we can use for grafting many kinds of grapes upon; chiefly such as are apt to degenerate, as the damask-grape, and the currant-grape, but it is better to graft the muscat-grapes upon plants of their own tribe.

49. Le teinturier, *i. e.* the dyer's grape, called also noirault, and plant d'Espagne, has its fruit very much pressed together upon the bunches, and is of a very black dye; its chief use is to heighten and colour the wine, though it is of great service also in the cure of wounds.

Thus far my friend's papers reach concerning the vines chiefly admired in *France*. It would be well if we could reconcile our *English* catalogues to those of *France*, that we might not send to that country for sorts which we have already, from catalogues that may be imposed upon us.

Concerning the improvement of old decayed vines, in a letter to a gentleman in Hampshire.

S I R,

As there is nothing more desirable than gaining or saving of time to a gentleman who is a lover of planting,

ing, my design in the following directions is to put you into immediate possession of good fruit; though I must confess, after wall-trees have been in a manner lawless for two or three years, and have run at random without controul, it is hard to bring them again to the good dispositions they enjoyed, whilst they were regulated by judicious government; and the vine especially, which is a plant that above all others is most inclinable to ramble out of rule, if it be suffered to take its own course, requires the skill of the gardener more than other trees, to bring it into healthful order; and in this our dressing and ordering it must be agreeable, partly to the rules of art, and partly to the laws of its own nature; for without both these considerations we shall never bring it to that good order we desire.

We must know, first, that all vines bring their grapes upon shoots of the same year, and those shoots, as well as the grapes they produce, are much fairer and better furnished, as they sprout from large shoots of the former; for those which spring from the old black wood are faint and weak, affording only small bunches of grapes, that ripen later as they are more remote from the earth: therefore what is practised by the best artists, is to keep their vines low, and lay the branches for bearing as near the ground as possible, by which means the fruit is larger, and ripens much sooner; but especially, if we bury part of them in the earth, so as they may take root, for then they are doubly nourished, viz. from the root of the mother-plant, and from the fibres which strike out of the layers, and we may yet help these young shoots in their growth, by laying little balls of soft soap for the roots to strike into.

In the case now before us, the vines may be brought into method two ways; first we must disengage them from the walls, and dismember them of all the smaller shoots, leaving only such of the new ones as are as thick

thick as one's little finger, or the largest we can find of the same year; which if they are strong shoots, we may prune to a yard or more in length, or leave them shorter in proportion as they are less vigorous. When the vine is thus ordered, dig up the ground about it, and bend down the whole vine as near the earth as possible, making it fast with strong hooks or stakes, so that the spring of the body of the vine may be curbed in such a manner, that it shall not at any time stir the young layers, or draw them out of the earth; for every shoot after it has been pruned as above directed, must be laid in the ground two or three joints at least; and the parts of them which rise out of the ground for bearing, should be tied up to stakes of four feet long; for though perhaps, when you lay them down in *November*, they may not appear longer than a foot above ground, yet you must provide to tie up the young shoots which will sprout from them the following summer; thus you shall have a little vineyard in one year bearing fruit, made out of one single plant, if it be large and well furnished with branches. And when the fruit is ripe, you may cut the layers from the old vine, and place its stem or body with the strong shoots it has made that summer against the wall you took it from. In the time when you first lay down this vine in the earth, you may contrive to place a layer or two near the wall, so that they may remain there; and I think it would be well enough worth while to provide pots for the other layers to be drawn through, rather than lay them in the naked earth, because when they have ripened their first fruit, you may remove them where you please, without hazard or any loss of time.

The second way I would prescribe for the improving such old unruly vines, though they were grown very high, should be to prune them as before directed; and where there happens to be proper shoots for bearing at some distance from the earth, they should be drawn through garden-pots fastened to the wall in iron-

iron-rings, and filled with earth, which will hasten the ripening of the fruit, and enlarge the bunches, as well as if they were to grow near the ground, and in effect nourish the whole tree; for every part of it will partake of the nourishment drawn from the earth in the pots, by the roots of those branches growing in them; but to assist the rooting of these branches, they must be now and then refreshed with water when the season is dry.

If we order a vine in this manner, we are sure of as many plants as there are pots. If we separate them from the old stock, or if we let them remain on the old vine, they may well enough last three years feeding on their pot-roots, and the mother root; but we should in the mean while encourage no other shoots of the old tree, but what sprout from the rooted parts in the pots, unless we design to make fresh pottings to supply the place of the first that are to be taken away.

I am, SIR, Yours, &c.

R. BRADLEY.

CHAP. III. *Of pears; a catalogue of the best sorts, with their description, culture and time of ripening; with curious observations relating to their names and qualities.*

THE following papers, relating to the culture of pears, were put into my hands by a very curious and experienced gentleman; and I am persuaded, will be of great use to the lovers of good fruit, as well from the directions given by him, for the management of the several sorts in the garden, as the bringing them to the table in the best perfection.

The great variety of pears require abundance of consideration, more than any other fruit: for although I do not take under my observation the whole catalogue

logue of them, yet the good sorts known to me are enough to fill a large part of my papers; chiefly because their culture is not the same for every one. The several species of these are of very different qualities; some are melting or buttered; others are crackling or juicy, and others more dry and odorous. They come in, or begin ripening betimes in the summer, even in *July*: and from that date we have pears that are in use all the year; some of the late winter pears keeping well, till nature ripens new fruit for us.

JULY PEARS.

The most early pears are ripe, or fit for eating, about the beginning of *July*. The little muscat, or sept en guille, as some of the *French* gardeners call it, is the first ripe. It is the best, and has by much the richest flavour of any of the little forward pears, though they are of several kinds; and there should not be wanting a few of them in a garden, notwithstanding they last but few days. The little muscat brings its fruit in clusters, much better in espaliers than standards, or the open air.

The gros muscat, or great muscat, does not bring its fruit in clusters like the former, but has the same flavour. It is larger, and requires likewise the assistance of a wall.

Le petit muscat bâtard, or little bastard muscat, is also called by the *French*, poire guenette, or genetting. It brings its fruit in clusters, and bears well in any situation; but has not the rich flavour of the two former.

Le muscat a longue queue, or long stalked muscat-pear, is a good fruit and agreeable to the eye. It is pretty large, and remarkable for its long stalk. It is a great bearer.

Le bourdon musqué, or muskt drone-pear, is a large early muscat. The fruit is round, high flavoured, and the tree bears well. It must be eaten a little

little greenish, being subject to rot in the heart when it is full ripe.

The hasting-pear, or la poire hativeau, follows that muscat first ripe; it yields a round yellow fruit, of a pretty good flavour; bears well, and should be eaten before it is full ripe, for it quickly grows mealy, and rots like the other summer-pears.

Le gros hativeau, or great hasting-pear, bears in clusters, and in abundance. The fruit is yellow and red, finely painted. It will not keep, and is much better eaten a little green than full ripe.

Le hativeau blanc, white hasting-pear; or as some *French* gardeners call it, le milan d'esté, or the summer-milan pear, is large, whitish, and so melting, that it bears the name in some places of burée d'esté, or summer-burée.

La poire de la magdelaine, or magdalen-pear, is almost round, rather green than yellow; of a pretty good taste, and large for a forward or hasting-pear. It grows mealy even upon the tree, if it be too ripe.

La bellissime, *i. e.* the fairest, or figue musquée, *i. e.* the musked fig-pear, is large for a forward sort; it is called bellissime for its great beauty, being of a fine yellow streakt with red. It has a rich flavour. Its wood is very large and strong, and its leaves round, and bigger than ordinary. It is also called by some *French* gardeners, bonne deux fois l'an, *i. e.* good twice a year; for it blossoms about midsummer for a second crop, and brings that fruit sometimes to perfection in *September* and *October*. It may be, that it was called the fig-pear, because of its bringing two crops of fruit in a year, or at least for its attempting to do so.

La supreme, *i. e.* the supreme, or poire de figue, *i. e.* the fig-pear, or grosse jargonelle, *i. e.* great jargonelle, or giberish pear. It is a large long pear, of a reddish yellow, its juice very sweet, and not subject

subject to be stony; it must not be over ripe for eating, for too much ripeness makes it meaty.

La cuisse madame, i. e. the lady's thigh, is a good pear, well known and admired. It is a long fruit, of a reddish grey when it is full ripe; the flesh is firm, and the juice very sweet; it will keep some time.

Le gros & petit blanquet, i. e. the large and small blanket pears, which are well esteemed. The small sort is by some called *poire de perle*, i. e. pearl pear; they are of a rich water, or their juice, in other terms, has a rich flavour; they are both good, of a yellow colour, and keep pretty well. The tree has a good appearance, shoots strong, and bears very large leaves. The large sort is likewise called *la musette d'Anjou*, i. e. the Anjou bagpipe.

La poire admiré, i. e. the admired pear, is round like that sort called *poire ognonet*, i. e. little onion pear; its juice is extremely sweet and high flavoured, and it is an extraordinary bearer.

L'admiré Joannet, i. e. the admired little John, is less and longer than the former. It is so called, because its time of perfection is about St John's-day.

L'admiré roux de Tours, i. e. the admired russet of Tours, or *la poire de Cypre*, i. e. the Cyprus pear, is the best pear of this month, almost round, of a brownish grey colour. Its flesh is firm, and its juice sugared and richly flavoured.

La poire d'ambre, i. e. the amber pear, or by some called *poire a la reyne*, i. e. the queen's pear, or muscat Robert, is a small pear, very yellow, shaped like the muscat, but larger. Its flavour is extremely rich, it is a good bearer; and it makes a handsome tree with yellow wood.

Le roussilet hatif, i. e. the forward little ruddy, or russet pear, named also *perdreau musquée*, i. e. the musked partridge, is very like the common roussilet, and is nearly as good, its juice being very delicious.

Memo-

Memorandum. I observe, that the pears mentioned by Mr Merlett for *July*, come little later with us, than they do about *Paris*; there is hardly more than ten days difference.

AUGUST PEARS.

In *August* the following pears are fit for eating; viz.

La poire d'Espagne, *i. e.* the Spanish-pear, or as it is called by some *French* gardeners poire de St Sanson, or St Sampson's pear; it is large, long shaped, yellow and melting; it bears abundantly, and should be gathered before it is ripe, to give it its beuree, or buttered-quality. This pear in some places is also called grosse cuisse madame, *i. e.* lady's great thigh, and at *Orleans* poire de beau preset, *i. e.* a pear worthy to be presented.

La jargonelle is long and redish, but not so long as the former; it is a little dry and stony, but has a good flavour, the juice being rich and high tasted.

Le parfum de Pan, *i. e.* Pan's perfumed pear, is pretty large, rather long than round, like the pear called in *French* sucree vert, *i. e.* green sugared pear. Its juice is extremely sweet and rich in flavour.

La poire de jassemin, *i. e.* the jessamine-pear, or vilaine de la reele, is of midling size, somewhat longer than round; its juice is rich, but the fruit is subject to be stony.

La grosse mouille bouche, *i. e.* the great-mouth water-pear, or coule soif, *i. e.* quench-thirst, or as some other *French* gardeners name it, le franc-real d'este, is a large round pear, greenish and melting, of a pretty good taste; but growing mealy if not gathered a little before it is ripe; the stalk is thick and short; it is a good bearer.

La chair d'Adam, or Adam's flesh, or la poire de prince, *i. e.* the prince's pear, is not unlike the
rousselet;

roussellet; it has a rose-watered juice, is very high flavoured; bears well, and may be kept long enough without rotting, which is too generally the fault of the summer-fruits.

La vallée, *i. e.* the valley-pear; or poire de liquet, the juicy pear, is watery, and somewhat harsh now and then, so that it is not at present so much in esteem as it has been formerly.

La poire a deux testes, *i. e.* the double-headed pear, is crackling, and full of sweet juice; it will keep and ripen well after it is taken from the tree; its fruit grows very large and good upon dwarfs.

Le gros & le petit ognionet, *i. e.* the great and small onion-pears, are musked and high flavoured; round, flat and yellow, shaped somewhat like onions; they are subject now and then to be stony, but are excellent bearers.

Le gros roussellet de Rheims, *i. e.* the great roussellet from Rheims, is generally allowed by all to be one of the best summer-pears: it is buttered and melting, with a musked flavour, and brings much larger and fairer fruit in espalier than on open ground.

Le petit roussellet, *i. e.* the small roussellet, is greyer and more russet than the former; it does not rot so soon; it brings its fruit to good perfection in a standard, and by that method keeps longer, and is better tasted: this fruit is so much coveted, that we plant it in all manner of exposures, to preserve it the longer among us. It is called about Anjou, le girofle, *i. e.* the clove-pear.

La poire sanguinaire, *i. e.* the bloody-pear, is rather a curiosity than valuable at the table; it is somewhat like the valley-pear aforementioned, but is red within-side quite to the core: it should be gathered before it is ripe, for it is of very short continuance.

La poire de franchipane, is small, green and longish; its juice is extreamly sweet and delicate.

La cassolette, *i. e.* the perfumed pear, or friolet; or as it is called in *Poitou* muscat yard, *i. e.* green muscat; in *Bigou* it is named, la verdette, *i. e.* the green pear, or la poire de taste ribaut; it is long and greenish, with a musked juice, it is a great bearer, and makes a fine tree; and though it is a crackling or brittle pear, its flesh is tender: it keeps pretty well for a summer-fruit.

La poire d'admiral, *i. e.* the admiral-pear, is reddish, rather flat than long; it is very juicy, with a delicate tender flesh; bears well, and is never stony: it is highly esteemed.

La poire de Lombardie, *i. e.* the lombardy-pear; or as it is called by some la poire de Milan, *i. e.* the milan-pear; is large, long, and of a high musked flavour, when gathered in time, a little before it is ripe: it is a good pear with a sugared juice.

La gros blanc, *i. e.* the great white, is a large pear, long and slender towards the stalk, and pretty big about the head: it is white and very melting; it should be eaten a little before it is ripe, for it decays quickly; the tree is handsome, with large shoots and very large leaves.

L'odorante musquée, *i. e.* the musk smelling-pear, called in some places poire de baume, *i. e.* the balm-pear; likewise, poire d'amidon, *i. e.* the starch-pear; or else, poire de fourmi, *i. e.* the pismire-pear, and also, verge d'or, *i. e.* golden-rod; is longish, very yellow, dry, and highly perfumed.

La brute bonne, *i. e.* the good brute, is thus called, because of the coarseness of its flesh; but it is very juicy, sweet, and high flavoured: it is a green pear, and should be eaten betimes; its wood and leaves are whitish and satineous or powdered.

La bergamotte d'esté, *i. e.* the summer-bergamy, or bergamot, is called by some, bergamotte de milan, *i. e.* milan bergamy; and bergamotte de la beurriere,

beurriere, *i. e.* the butter-woman's bergamy; it is a large green pear, soft and melting; and is in many respects like the autumn-bergamy, having its particularities which are excellent.

La fosse musquée, or la bergamotte Greque, *i. e.* the Greek bergamot; which they call in *Anjou* la poire de violon, *i. e.* the fiddle-pear; is almost round, yellow, and a great bearer: it is one of the best pears for plenty of juice and rich flavour.

L'inconnue chefneau, or la fondante de Brest, *i. e.* the melting pear of Brest, is rather long than round: its juice is good and rich; it is an extraordinary bearer, and in some things resembles the double-headed pear, or poire a deux testes; which is rather rounder and less red than this; it is ill-named a melting-pear, for its flesh is rather brittle or crackling, than buttered and melting.

La grise bonne, *i. e.* the good grey pear; or la poire de forest, *i. e.* the forest pear; also called la crapaudine, *i. e.* the toad-stone pear; or else l'ambrette d'esté, *i. e.* the summer-ambret; it is also named la rude épée, *i. e.* the sharp sword-pear, because of its prickly wood; the fruit is of the pear-make, neither long nor round, it is of a greyish colour, a little buttered or melting; the juice is sweet and pleasant.

Le muse d'esté, *i. e.* the summer musk-pear, otherwise called le muscat de Savoie, *i. e.* the Savoy-muscat, or poire aux mouches, *i. e.* the fly-pear, or l'ognon de Vernon, or Vernon's onion-pear, is a kind of red orange-pear, less round than long; it is large and beautifully coloured with yellow and red; it lasts a long time.

Le poire d'orange, *i. e.* the orange-pear, is of several kinds; l'orange commune, *i. e.* the common orange-pear, is small and greenish; l'orange royalle, *i. e.* the royal orange-pear, is an handsome large fruit, and very good; l'orange musquée, *i. e.* the musked orange-pear, is of a flatter make, and should be eaten

before it is full ripe, for it is very subject to rot at the heart; and so the other orange-pears should not be suffered to hang too long upon the tree before they are eaten, for they lose their goodness.

La poire de lichefrian, is longish, and of a russet grey; it is a great bearer, and is soft and melting.

La poire d'eau rose, *i. e.* the rose-water pear, or by some called caillo-roses, *i. e.* the curled rose-pear, is grey and round, the stalk is very short, and the juice sweet, and of a rose-like flavour.

La muscat d'Aoust, *i. e.* the August muscat, is called la poire d'avarat, *i. e.* the averat-pear, or poire de robine, or poire de la honville, *i. e.* the hanville-pear, or poire royale, *i. e.* the royal-pear, is flat and round, and has a hard flesh. The fruit comes in clusters, and is of an high musked flavour, and one of the best: there is the great and small of this sort. There is one of this kind harder, and drier than the large sort, which has the richest musk of any pear.

Le parfum d'Aoust, *i. e.* the August perfumed-pear, or la poiré de berny, *i. e.* the berny-pear, is longish, large, and of a good taste. It is greenish and spotted.

La eramoisine, *i. e.* the crimson-pear, is a small pear, a little longish, somewhat like the blanket-pear, but thinner; the juice is very sweet, and it is a great bearer.

Le bon chrétien musquée, *i. e.* the musked bon chrétien, or good christian, or poire sans peau, *i. e.* the pear without skin, is rounder and smaller than the summer-sort; its skin is yellow, and its flesh pretty hard; it is one of the best pears, and the most in esteem; its juice is very sweet and delicious. It must be grafted upon a free stock, for it seldom comes to any thing upon the quince, and is so fickle, that even though it is grafted upon a pear or free stock, it lasts but a few years; it thrives better from a bud than from

clef-

clest grafting, for the cion languishes till the incision is intirely recovered.

SEPTEMBER PEARS.

In *September* the following pears are fit for the table; viz. le bon chrétien d'effé, *i. e.* the summer bon chretien, or by some called gracioli, *i. e.* the delicate pear; it is a large yellow pear, with tender flesh, full of fine sugared juice, of a longish make; it is a pretty good bearer, chiefly about the tops of the branches, which should not be cut off from more than those trees that bear in the same manner.

La poire de salveati, is pretty large, round, and flat; its stalk is long and slender; its fruit is fair and handsome, of a fine yellow; it is melting, and will keep pretty well; it is one of the sweetest pears, and may be reckoned among the best.

La chambrette, *i. e.* the chambrette pear, is large and longish, with a very agreeable melting flesh; it is so named, as being first brought among us by the Marquis of *Cambray*, the author of the *virgouleuse*-pear; some call it la chambrette d'hiver, *i. e.* the winter chambrette.

La poire d'ange, *i. e.* the angel-pear, is somewhat like the salveati; it is flatter and more melting, but has not so rich a flavour, nor quite so sweet a juice.

La poire de mon Dieu, *i. e.* God's pear, is an handsome fruit, and pretty good, of a yellowish red, juicy enough, and not subject to be stony; it is a very good bearer, and the pears ripen upon the tree at some different spaces of time from one another.

La poire de rose, *i. e.* the rose-pear, has a large round fruit, of an onion-make; its stalk is very long and slender, its flesh is a little hard, it has a rose-watered juice, and is very good.

La verte longue, *i. e.* the long green pear, is also called mouille bouche d'automne, *i. e.* the autumn mouille bouche, or autumn mouth-watered pear; its

fruit is long and of a green colour when it is ripe; it is very melting, and of a very rich juice, especially when it grows in such land as is rather dry than wet; it thrives better upon a quince stock.

La verte longue Suisse, *i. e.* the long green pear of Switzerland, or *poire panachée*, *i. e.* the streaked or striped pear, has the same qualities with the former; its wood is marked with yellow and green, and its fruit is a little striped, and even some of its leaves. I found this fruit at *Baudeville*, where it was in great esteem, and a rarity.

Le beurée rouge, *i. e.* the red beurée, or red butter-pear, is called likewise by some *French* gardeners *beurée d'Anjou*, *i. e.* the Anjou butter-pear; some name it *poire d'amboise*, *i. e.* the amboise-pear. In *Normandy* it is called *isambert le bon*, or the good isambert; it is a large pear, long, not pointed, but well coloured; it is so buttered and melting, that it well deserves its character of beuree; its juice is sugared and high flavoured; and it ripens off the tree like the other beurées, which should be gathered before they are quite ripe: it is the best pear of this season, as the *rousselet* is of the summer-pears, and the *bon chretien* of the winter.

Le beurée gris, *i. e.* the grey beuree, or grey butter-pear, comes later than the former, and is tart and more melting; but the green beuree is the least melting of any of the butter-pears; its juice is more flat, and its flavour less rich. To keep the beuree a long time in eating, we must let them hang upon the tree till they drop, and plant some trees of them against a wall, to the western aspect.

Le beurée blanc, the white beuree, or by some *French* gardeners called *beurée à courte queue*, *i. e.* the short stalked beuree, but most commonly called *doyenné*, or the dean's pear, also *poire de St Michel*, *i. e.* St Michael's pear, or Michaelmas-pear; by some again, it is called *poire de neige*, *i. e.* the snow-pear,

or

or la bonne eme, *i. e.* the good graft; it is a fair, large and good fruit, of a citron-colour, and is by some called poire de citron, *i. e.* citron or lemon-pear; it is very melting.

Le parfum d'Acoust, *i. e.* the perfumed August-pear, and the brute bonne, are likewise fit for eating part of this month.

OCTOBER PEARS.

The following pears are fit for eating in *October*; viz.

The messire Jean, is of several sorts; there is the white, the gilded, and the grey; the white sort ripens first, has its flesh more tender than the others, and its juice less sugared; its whiteness seems to proceed from some distemper in the tree; for when the tree is very vigorous, the fruit is better coloured.

Le messire Jean dore, *i. e.* the gilded monsieur John, has a more richly sugared juice than the former, is not so subject to be stony as the grey sort which comes later, will keep pretty well, and has an extraordinary rich juice; this is one of the best and most antient fruits, is for eating all the autumn-season, when people are, for the most part, in the country; and therefore one should have plenty of them; the first of these is corruptly called, in some places in *England*, the John Dory.

La poire de vigne, *i. e.* the vine-pear, by some called damoiselle, *i. e.* the lady's pear, and also la longe queue d'Anjou, *i. e.* the Anjou long-tail; it is round, of a greyish brown-colour, very melting, and of an excellent rich juice; the stalk is extraordinary long; the fruit should be gathered before it is full ripe, otherwise it grows mealy and soon rots.

La bergamotte d'automne, *i. e.* the autumn-bergamot, is a pretty large green pear, a little rough coated, of a flat make, and very melting; it ripens after it is gathered from the tree, and then changes its

green to a yellowish-colour; it keeps pretty well. To bring this fruit fair and good, and to make the tree give us good wood, and consequently good fruit, we must expose it to the rising or setting sun, and by no means to the violent heat of the south sun, which would canker the wood, and make the fruit small and full of cracks. It seldom answers our expectations upon dwarfs; but in that case the shoots must be pruned long, if we expect our wood to be well nourished and profitable; it is one of our best fruits, but we seldom find trees enough of this sort in the fruit-gardens. The autumn-pears should always be more in number than the others, because the autumn fruit is almost half our diet, and is wholesome. We should plant some of this kind of bergamot to the setting sun; the juice indeed will be less perfumed, but the sweet or sugared taste, which is the excellency of most winter-fruits, will make good the want of the high flavour. The water, or juice of the bergamot, is the coldest of all fruits.

La bergamotte Suisse, *i. e.* the bergamot of Switzerland, is scarcer than the others; it is a flat made fruit and very melting, streaked with green and yellow, and its wood the same; it bears well and covets a wall, but little sun. This pear is no less good than curious, and is the forwardest of the bergamots, and the very best.

La bergamotte musquée, *i. e.* the musked bergamot, or la poire du colombier, *i. e.* the dove-pear, or poire de Sicile, *i. e.* the Sicilian pear, or le petit muscat d'automne, *i. e.* the little autumn muscat, is a small dry pear, very high flavoured, a great bearer, and makes an excellent sweetmeat.

La bergamotte bâtarde, *i. e.* the bastard bergamot, is large and flat, streaked with grey, bears like ropes of onions, its flesh is brittle, of a pretty good water, and should be gathered a little before it ripens.

La bergamotte tardive, *i. e.* the late bergamot, or bergamotte de pâques, *i. e.* the Easter bergamot, is
more

more in esteem than the former, because of its long keeping, though its other qualities are the same; it is very common in *Anjou*, but very rare about *Paris*.

La belle & bonne, *i. e.* the fair and good pear, is a large pear, long and pointed, of a greyish red; the flesh is tender and delicate, but must be eaten just in time, for it presently decays.

Le petit oing, *i. e.* the little lard pear, is of a middle size, almost round, but of unequal shape, rather green than yellow; it is one of the most melting delicate pears, and bears very well.

Le besif d'Hery, *i. e.* the wilding of Hery forest, is a round, yellow, rough coated pear, of a middle size, better baked than raw, having a fennel-like flavour, which is good in baked pears. It comes from the forest of *Hery*, in the lower *Britany*, whence it took its name. *Besif* or *besier*, signifies *wilding* in *Britany*, *Normandy*, and several other provinces.

Le chat brulé, *i. e.* the burnt cat, otherwise called *la pucelle de Xaintonge*, *i. e.* the Xaintong virgin, is a little longish and pointed, very brown, melting, and of a rich water; it presently grows mealy.

Le bec d'oye, *i. e.* the goose-bill-pear, commonly called *le Martin sec de Bourgogne*, *i. e.* the Burgundy dry Martin-pear, is a small pear, almost round, of a reddish brown; its stalk is thick and long, it is a little melting, and is well tasted.

La poire de St Denis d'Angers, *i. e.* St Denis of Anger's pear, is large, fair, long, and yellow; its flesh is brittle and crackling, and its juice richly sugared; it is much esteemed about *Anjou*.

L'amadote, *i. e.* the amadot-pear, is flat shaped, yellow, dry and high flavoured, with a rough coat; it is so called from being found first in a wood in *Burgundy*, belonging to the Lady *Oudotte*; when it was wild its wood was full of thorns, but by cultivating it upon quince-stocks, it loses its thorns, though upon free-stocks it retains them; but yet upon the free-stock the fruit

fruit is preferable; it then has more juice, and is more melting, and indeed may be placed among the best. This fruit, as well as other dry and perfumed fruits, are much better upon dry soils than upon wet and moist land; the latter bringing large, but watry and insipid fruit. It should be chiefly observed, that all of the melting or butter-pears, which seldom are very high flavoured, should be planted in light soils; and it has been an observation worthy notice, that the beuree pears, or those that are melting like the thorn-pear, l'échasserie, &c. are greatly improved by grafting them upon the amadotte; for the juices or sap of the amadotte is musked and richly flavoured; and the beurees or melting-pears which are grafted upon it, are perfumed by it.

Poire St Francis, *i. e.* the St Francis-pear, is very large, long, and yellow; it bakes very well, but is rather too harsh to eat raw.

Poire de ronville, *i. e.* the ronville-pear, is large, long, and green; but grows yellow in ripening; it bakes well, but is extremely good roasted in wood-embers.

L'épine rose, *i. e.* the thorn-rose, is of two sorts, the earliest ripe is rather long than round, and brings a fair large fruit, intermixt with yellow and grey; it has a strong rosy flavour. The latter sort is somewhat like the portail, or gate-pear; it is flatter, and has less of the rosy flavour than the forward kind.

Poire de lansac, *i. e.* the lansack-pear, also called la Dauphine, *i. e.* the Dauphin-pear, comes from a village named Haze; it is a small, round, yellow, rough pear, and one of the most melting sorts: it is esteemed one of the best. It holds fit for eating a long time, even till *January*, if it is gathered late; for it will hang upon the tree after the leaves are fallen, and till the hard frosts begin; it is likewise called franchipane d'automne, *i. e.* the autumn-franchipan, because of its rich sugared juice, but it is better known
by

by the name of Dauphin-pear. Madame de Lansac, who was lady of *Honè*, was governess to the Dauphin of France, afterwards Lewis the fourteenth, and in that time it was named the Dauphin-pear.

PEARS good in NOVEMBER.

In *November* is fit for eating the *virgouleuse*, which came from the village called *Virgoulee*, near *Limoges* in France, of which place the Baron of *Châmbrey* was Lord; so that in this country it is called the *chambrette*; it is a large, long, green pear, which grows yellow in ripening; it is one of the firmest beurees, and is very good; it lasts fit for the table a long time, but must not be kept close nor laid upon deal-boards, or straw, no more than the other beurees, or melting pears, which are apt to take the taste from any thing they touch: but they may safely be laid upon shelves made of oak, or covered with plaister of *Paris*; or else if we have any particular flavour which we would give them, we may perfume skins of leather to our liking, and lay these pears upon them, they will soon take the scent we design them. The tree is one of the fairest of all the pear-trees, as well for the fine verdure of its leaves, as for its plenty of sap, which pushes forth large and vigorous shoots; therefore where a tree dies or languishes, plant a *virgouleuse* in its place, and it will soon fill the vacancy: however, one may have too many of them; but what I say is only to inform a young gardener, that the *virgouleuse* will sooner make good a deficiency in a plantation, than any other good pear-tree that I know of.

If we gather this fruit before it is ripe it is apt to wither; it rather chooses to be cultivated as a dwarf than a standard, for the fruit is very tenderly joined to the tree, and a little wind breaks it off; and if it hangs too long upon the tree, it loses its excellence, and is hardly brought to mect, but it lasts the longer.

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We may treat this sort in espallers, or against walls lying to the east or west sun, but never to the south, which makes the tree turn yellow, and cracks the fruit, nor in that case will the fruit keep.

There is one sort which is very rare, the wood is red, and the fruit of the same colour; it is fit for eating somewhat later than the other, and lasts good till *February*. It has the same qualities with the other virgouleuse, except that it is less melting or buttered. We should graft this rare sort upon the common virgouleuse, if we expect the fruit large and in perfection.

L'ambrette, i. e. the ambrette, is a round pear, of a greenish grey colour, in strong stiff ground, but is whitish in sandy land; it is very melting, and of a rich water. I esteem it one of the best pears, though it is a wilding, as may be discovered by its thorny wood. It brings better fruit, by being grafted upon the quince than upon the free-stock; the latter subjecting the fruit to be stony, and of a greener colour than the other, as it retains more of the wilding; but the quince-stock softens and rectifies it; this fruit is in high esteem every where.

Le marquis, i. e. the marquis, is a large green pear, which grows yellow in ripening. It is in many things like the winter bon chretien; its stalk is long and slender, and its flesh very melting and buttered, its juice sweet and richly musked, somewhat sugared like the the water of the messire Jean pear; it makes a good tree, and bears well; and the sap is so vigorous, that it is always well furnished with wood; this pear is one of the best.

La poire de Malth, i. e. the Malta-pear, by some called poire de pretre, *i. e.* the priest's pear, is almost round, and is streaked with grey and brown; its stalk is thick and short; its juice sweet, and of a rose-like flavour; it holds a long while in eating; and though the

the flesh be crackling and brittle, it is tender and delicate.

La poire d'épine, i. e. the thorn pear, is green, and almost of an oval figure; it has a little swelling near the stalk, which renders that a little fleshy. It turns yellow in ripening, and is very melting and high musked. I think it one of the best melting pears we have; especially if it be upon a free-stock, for upon the quince the fruit soon decays. Why it is called the thorn-pear, I cannot conceive, for there are no thorns upon the tree; the ambrette might rather deserve that name, whose wood is very thorny.

By experience I find the fruit is much better in light sandy ground, than in flat heavy land; for in the latter, it is always watery and insipid; and in that case we should put sand about the roots, rather than dung; for I find, that sand so applied gives the fruit a rich flavour. We should likewise do the same to peach-trees, fig-trees, and some others, when they are planted in heavy ground; for though in a strong soil they bear large fruit, it is seldom good for any thing.

L'obergement, is a large pear, very like the franc-real in fruit, wood, and leaf, and might justly be named the franc-real beuree. Its juice is sweet, and it is a great bearer, bringing its fruit the length of the shoot, or like ropes of onions: this does much better upon a free-stock, than upon the quince; for upon the latter it is soon mealy, and should rather be eaten a little green than ripe. We should observe, that those fruits which are subject to rot soon, or grow mealy, are much mended by grafting upon free-stocks; for the quince, which brings a dry harsh fruit, communicates its harshness and dryness to the fruits grafted upon it; and likewise such kinds of fruit should be gathered sooner than others, before the sap slackens in its motion, for then the fruit dries and rots sooner than those which have had less time upon the tree.

Louise-

Louise-bonne, is a large pear, of a very long make, and of a pearl-like figure: it is whitish and very melting, if we do not eat it too soon. It comes from *Poitou*; the Lady of which place was named *Louise*, and had so great an esteem for this fruit, that it was called the *Louise-bonne*, or good *Louisa*.

Le Martin-sec de Champagne, i. e. the Champaign dry Martin-pear, is rather long than round, well coloured, and streaked with red and grey. It has a sugared and high flavoured water, but is a little subject to be stony. It bears abundantly, and is for eating about three months. It is in high esteem every where.

Parfum d'hyver, i. e. the winter perfumed-pear, is an excellent pear for baking; it is large, round, and well coloured with yellow. It is a good bearer.

Citron musquée, i. e. the musked lemon, or citron-pear, is almost round, finely coloured with yellow and red, very high flavoured and a little dry; but it is to be watched and taken when it begins to smell, for then its water is more delicate and soft to the palate. It is better in moist grounds, than in dry sandy places, as are most of the dry perfumed or musked pears.

La poire de jalousie, is large, and resembles the pound pear, but is yellower and more pointed towards the stalk; its flesh is so melting, and its water so richly sugared and perfumed, that with good reason it may be said to excite jealousy among the pears of this season, as its name intimates. It should not be too ripe when it is gathered, for in that case it would be too melting, and keep little; for most of the melting pears rot quickly, if they hang too long upon the tree. This sort upon the free-stock keeps a long time; but when it is grafted upon a quince-stock, the fruit soon decays.

Le bezy de Quisloy, is a little pear, almost round, very brown and melting. It was first found in the forest

forest of *Quissoy* in *Britany*, where it is called *ruffet*, or *petit beurée d'hiver*, i. e. little winter-beurée. Its water is extremely rich and vinous, preserving still something of the wilding it was taken from; it is an extraordinary bearer, and brings its fruit in clusters.

La parfum d'autumn, i. e. the autumn perfumed-pear, is pretty large and long, it is very much musked and high flavoured for one of the *beurée*-race, or such as have a melting flesh.

Le saffron d'hiver, i. e. the winter saffron-pear, is by some called *orange de St Lo*, i. e. *St Lo orange-pear*; the fruit is large and round, and of a grey-colour; its flesh is very melting, and of a yellow-colour; it lasts good a long time, is well esteemed, and bears very well. It does better upon a free-stock than upon the quince.

La rouffeline, is very like the *Martin-sec de Champagne*, or *Champaign dry Martin-pear*, but is a little more pointed, and yellower. The stalk is very long and slender, like that called *poire de vigne*, or *vine-pear*. It is one of the best *beurées*, delicately musked, like the pear named *robine*, which, in my opinion, is the best of the musked-race. It is likely this fruit was named *rouffeline*, because its melting flesh, and extraordinary musked flavour is somewhat like the *rouffeler*. If this fruit was more constant in its ripening and perfection, I should esteem it the best of the winter-fruits; but some years it is dry and high flavoured, and in others, it is melting and of a very different relish; so that the palate does not know what to expect from it.

Bergamotte cressane, is large and flat, and of a yellowish grey-colour; the flesh is very melting, and the juice richly sugared and vinous. It is a rare and excellent fruit, brings a great deal of wood; and is much better upon the free-stock than upon the quince.

DECEMBER PEARS.

In *December* the following pears are in season; *viz.*

La vilandry, or by some called *le bezy*, is a pretty large pear, almost of an oval shape, and of a yellowish colour, very melting and well flavoured, especially when it grows in light sandy land; it lasts good a long time, and is a good bearer, bringing its fruit in clusters: the tree makes a good appearance, the leaves are very long, narrow and pointed; and the fruit may very justly deserve our care as one of the best of this month.

L'épine longue d'hiver, *i. e.* the long winter thorn-pear, is by some *French* gardeners called *verte longue d'hiver*, *i. e.* the long green winter-pear, and in some places the winter mouille bouche; it is very melting, and of a rich water; it is somewhat like the autumn thorn-pear, but is rather larger and longer, and does not grow mealy in ripening: it lasts a long time, and is one of our best pears.

Poire de satin, *i. e.* the satin-pear, is almost round, white and smooth-coated; its flesh is very melting, and its water extremely sugared; it lasts good three months, and brings plenty of wood and fruit every year, which is somewhat particular in a pear-tree.

Colmar, is a large pear somewhat resembling the large autumn bergamot, but a little more pointed; its flesh is buttered, but not very melting, its juice sugared and rich; it bears well and shoots plentifully.

Merveille d'hiver, *i. e.* the wonder of the winter, is a roundish pear, but sometimes of an unequal figure; this is one of the best melting beurées; it is of a greenish-colour like the little bergamot, but is somewhat richer in its flavour.

Poire bronzée, *i. e.* the brass-pear, so named because of its colour, is much like a large bon chretien; it is a fair large fruit, fit for baking, and is richly flavoured by that means.

La Messire Jean d'hyver, *i. e.* the winter Monsieur John, by some called, marion d'amiens, and poire de yer, *i. e.* the worm-pear, is somewhat like the common Messire Jean, but clear and more pointed; it holds good a long time, its water is richly sugared, its flesh is brittle and crackling, without melting at all in the mouth.

La poire de mauritanie, *i. e.* the moor's pear; is of a black brown colour, a little touched with red, and a little pointed in its make: it is called by some le sucrin noir, *i. e.* the black sugar-pear; its juice is somewhat like that of the Messire Jean.

L'Archduc, *i. e.* the Arch-duke's pear, is round and yellow, resembling the pears called petit oing before mentioned, but is later and much better: it is melting, and has a sweet and agreeable juice; it is one of our best.

Beurée d'hyver, *i. e.* the winter beurée, is called in some places in *France*, le gatellier, and jenart-pear; it is large and green, of a long oval shape: its flesh is after the manner of the beurée race, but is better baked than raw.

La France real, or otherwise called in *French*, gros micet, is a large pear, almost round, of a yellowish colour; it is one of the best baking pears: there is a small sort of this which is round and yellow, and very dry, but well tasted; the kernel is very large, the fruit is lasting, and the tree bears well.

Le Milan d'hyver, *i. e.* the winter Milan-pear, called sometimes le Milan rond, *i. e.* the round Milan-pear, is not unlike the common bergamot, but its coat is less rough.

La poire de topinambour, is large, long, and yellow; and in ripening is very like the ronville-pear before described: it is highly perfumed; its flesh is brittle but tender, and its juice rich.

La poire de Portugal, *i. e.* the Portugal-pear, is not very large, but is high flavoured, and very agreeable.

La St Germain, or as some call it, l'Inconnue la Fare, is large and long; its flesh is buttered and melting, like enough to the virgouleuse; it is an extraordinary fruit for goodness and keeping, and holds in eating a long time; so that we should have a good many trees of it, which make a handsome appearance and bear well; we owe this excellent fruit to a wilding which was found upon the banks of the river *de la Fare*, in the parish of *St Germain*; and although it has been grafted and cultivated with all imaginable care, its wood is still inclining to be thorny; the leaves are long and narrow, and seem inclined to shut up like those of an orange-tree that wants water. Some have disputed whether the St Germain and la Fare are not two different fruits; for my own part, I shall not settle that point; if there is any difference, I think the St Germain is the smaller, greener, and less melting of the two; but yet the wood and the leaves are alike, and in some years their fruit is very nearly the same: however, I think the St Germain is worth all the winter-fruits; it has all the good qualities of the virgouleuse, and none of the bad ones.

La poire de Naples, *i. e.* the Naples-pear, is yellow, rough coated, flat, and its flesh of the beurée kind; it is a great bearer, its leaf is very long and narrow, and curled in a particular manner.

PEARS good in JANUARY.

During the month of *January*, and the following, the fruitery will furnish us with the bon chretien, which is of several sorts. There is first, the bon chretien doré, *i. e.* the gilded bon chretien, which is the tenderest and first ripe; then we have le bon chretien d'Anche, which has no kernel, or sans pepin; it is the best sort at *Anche*, but not about *Paris*; it colours like the other bon chretiens according to the aspect we give it, much better in espalier or against a wall, than in a dwarf. As the insect called the tiger
has

has shewn itself so powerful an enemy to this tree, we should not expose it fully to the south sun, but rather to the east or west, which indeed gives us greener fruit, but they nevertheless ripen well in the house, and come to a good colour: it is to be observed that in these cooler and moister situations, this tree preserves its leaves green and strong till the end of autumn.

Le bon chretien verd, *i. e.* the green bon chretien, has the most juice, and lasts till *April* and *May*, when it is cultivated upon a free-stock: in ripening it turns yellow. There is a long and a round kind, but the best is of a bottle-shape. We must be sure not to expose these sorts in too hot a place, for fear of insects, and the drying or scorching of the leaves, which stops the sap, and hinders the progress of the fruit. As a remedy against the insects subject to annoy this tree, we should wash all the parts of it in autumn and in the spring, just when the hot weather comes in, with fair water, which one may continue from time to time, as well as watering the roots now and then: some boil rue, wormwood, and other bitter herbs to wash their trees with, but I find fair water will do alone. There is another way that may be of some use in this case, which is, to spread a cloth at the foot of the tree about day-break, and with a tender brush to sweep these flies down upon the cloth and destroy them; for early in the morning, while the dew falls, they cannot take wing.

We owe this fruit to *St Martin*, who brought it from *Hungary* into *France*, at which time the people gave it the name of bon chretien, *i. e.* the good christian.

There is still another kind of bon chretien of *English* growth, or at least was brought from *England* into *France*; which might rather be called the moor from its black brown skin: this is much like the *French* sort

in its wood, leaf, and goodness; being of a tender flesh, and a rich sugared water.

To preserve the bon chretien and other late fruits, they should be gathered in fair weather, when they are very dry, and in the decrease of the moon, which makes them keep a long while without rotting; we may know when they are ripe, by their easy leaving the tree, which only happens when the sap is thickened; or is said to be without motion.

Le gros beurée blanc d'hyver, *i. e.* the great white winter beurée-pear, bears a whitish fruit, long and thick shaped, somewhat like the winter bon chretien; it is very melting, and full of a sweet and agreeable juice.

La poire de Fribourg, *i. e.* the Fribourg-pear, is a large fair fruit, of a yellow amber-colour; its flesh is crackling, but its juice is sugared and delicious.

L'orange d'hyver, *i. e.* the winter orange-pear, is large and round, green upon the tree, but changes yellow in ripening: its juice is sweet and agreeable, and it holds good a long time.

Poire de prince, *i. e.* the prince's pear, is excellent for baking: it is a large fruit, of a beautiful red colour, its juice is very agreeable, and it is not subject to be stony.

Le petit muscat d'hyver, *i. e.* the little winter muscat, is a round yellow pear, its flesh is a little dry, but very well tasted.

La poire de livre, *i. e.* the pound-pear, is also called le rateau gris, *i. e.* the grey rake pear, is a very large brown pear, good for baking.

La poire de St. Francois, or St Francis's pear; named by some poire grillant, *i. e.* the slippery pear; is very large and long, and of a brown colour: it is excellent when baked, having a rich musked juice, and is never stony.

PEARS good in FEBRUARY.

The pears fit for the table this month, are first, le rousselet d'hyver, *i. e.* the winter-rousselet, not much unlike the summer-rousselet, but is rather longer, and a little pointed towards the stalk; it is greener, and has less red in it than the summer-sort: its juice is richly sugared, and of a vinous flavour; the wood is red like the common rousselet, and the leaves of both are alike.

Le gros musc d'hyver, or the great winter musk-pear, called also, orange musqué, *i. e.* the orange musked-pear, and by some, poire Magdalaine, *i. e.* the Magdalen-pear, is round and green, but turns yellowish in ripening; its juice is highly musked, and it is one of the best of this season, though the grain of the flesh is a little coarse.

La pastorale, is a yellow long pear; its flesh is melting and extraordinary good; it keeps well, and is in eating a long time; but this as well as others is better or worse, as the season of its growth is dry or wet.

Le Martin fire, is a long pear, green and red; its juice richly perfumed, and it keeps a great while.

Le dagobert, is pretty large, long and red; it bakes very well.

La donville, by some called the calot, or poire de province, is large and long shaped, of a yellowish red colour, and not subject to be stony; it is much esteemed for baking.

Le bequesne, is long, more pointed, and of a browner colour than the donville; it keeps well, and is good baked. In the later season, we must be sure to have a stock of pears for baking, roasting or stewing, for they are preferable to raw fruit during frosty weather; even the bon chretien is mended by roasting in wood-embers.

La bergamotte d'Hollande, i. e. the Holland bergamot, is a very large, fair round green pear; its flesh is buttered, but its juice is not so rich as the other bergamots.

La bergamotte bugy, by some called poire Nichole, and poire du ministre, and in *Italy*, pere spina, is a large pear, almost round, but pointed towards the stalk; it is of a yellowish green, its flesh is buttered and melting, and it keeps well; it is apt to grow musty if it is kept close, and takes the flavour of any thing that touches it, therefore it should have air, and be kept like the virgouleuse, as I have before directed; it brings excellent fruit being planted against an east or west wall, but does not succeed so well in dwarfs or standards.

Poire de grosse, i. e. the clove-pear, is round, and of a greyish red; its flesh is firm, and its juice very sweet and well tasted.

La stergonette, is of a middle size, long and brown; its flesh is after the manner of the beurée, and its juice extremely rich for a late pear.

PEARS good in MARCH and APRIL.

We have now the St Martial, which in some places is called poire angelique, or la cristaline; it is very like the winter bon chretien, is full as long, but scarce so thick, and is as late in eating: its juice is sugared, and its flesh tender: it is an half beurée, and very well esteemed in *Languedoc*, but chiefly at *Toulouse*, by the name angelique; and at *Bordeaux* it is known by the name of the St Martial.

La poire de chaumontel, i. e. the chaumontel pear, otherwise called le bezy de chaumbutel, which is the wilding of that place, which lies near a town called *Lazarche*, in the way between *Calais* and *Paris*; is a large winter beurée, almost like the autumn beurée, but partaking a little more of the red colour; it is a melting

melting fruit, and its water sweet and rich; it is one of the best late pears.

It is to be observed, that fruit ripens sooner one year than another, which happens from the great heats, or much wet falling while they are in the growth, or ripening state; and we must observe too, that we are not to keep them too warm or close in the fruit-chambers. In soft winters, we should give them all the air we can in dry weather, but never open the windows in damp foggy weather, for such moist air disposes the fruit to rot. I have observed, that in moderate winters, all fruits hurry to maturity or ripeness, and soon rot; even the *virgouleuse*, unless it be kept airy; but in that case it holds good: those fruits which hang long upon the tree, are such as last the longest; and on the contrary, if fruits fall from the tree, or are gathered too soon, they will soon fade; but then their flesh has more of the *beurée* in it.

La bonne de foulers, is a kind of winter-bergamot, very melting and well tasted; it keeps a long while, and is one of the best.

La bergamotte de paques, *i. e.* the Easter bergamot, is green, its flesh is melting, and its juice is as good as that of the autumn bergamot.

Poire de fontarabie, or fontarabie pear, is called *carmelite musquee*, *i. e.* the musked carmelite pear, by some *bonne foy*, and *gros muscat de lion*, or *gros romain*: this is a large pear, rather long than round, yellow and tinged with red; its flesh is never stony; it eats well enough raw, but is an admirable baking pear.

Le cadillac, by some called *poire de pequigny*, *i. e.* the pequigny pear, or *poire de citrouille*, or the gourd, or pumpkin-pear, or *le tout-temps*, or everlasting-pear, is a sort of a white pound-pear, very large, flat, and white, fit for baking; its wood and leaves are likewise very large, and one cannot well be

without a tree or two of it, for the largeness and beauty of its fruit.

There are many other pears (says the gentleman that made the foregoing remarks) which one might mention as fit fruit for baking; or to follow the catalogues that are published, one might use names which have been imposed on fruits by strangers at their discretion; but that would confound us more than we were before.

Our author is therefore for abridging, as much as may be, the catalogue of fruits, that we may plant no sort but what may by their goodness invite us to regard their culture; his judgment passes for the beurées and melting pears, rather than those with brittle, crackling, or cassant flesh; and, as to my opinion, I join with him so far, that if one of the best beurées would hold for eating from *August to April*, that sort alone would answer our end better than the whole catalogue of pears to be eaten raw. The pears with the beurée flesh, says he, which are the best esteemed, should be cultivated in dry sandy land, which will prevent them from being stony; and on the contrary, we should plant the dry, high flavoured, or musked pears in moister soils^(a).

C H A P.

(a) All the sorts of pears propagated in gardens, are produced by budding, or grafting them upon stocks of their own kind; which are commonly called free-stocks, or else upon the quince or whitethorn stocks; but the last are now generally disused, the fruit produced this way being apt to be dry and mealy. The quince-stocks are, however, in great esteem for the trees designed for dwarfs or for walls; because they do not let the shoots grow so fast and luxuriant. But there are objections against even these, which are of some consequence; for there are many kinds of pears which will not do upon them, but will die, or become weak and good for nothing after three or four years; and the hard-breaking pears are rendered very unpleasant by being grafted on these stocks,

CHAP. IV. *Of plums; a catalogue of the best sorts, with their descriptions, and some useful particulars relating to them.*

THE plum is a fruit which is as much in esteem as any fruit whatever: its great varieties, either for eating raw, baked, or in sweetmeats, makes it deservedly take place among our best fruits.

We have plums from *July* till the end of *October*, and even later; but the sun at that season of the year has so little force, that we cannot boast of any good fruit of this kind after *October* is passed (a).

The stocks, while the buttery or melting ones are meliorated by them. And it is to be added, that no sort of pear will thrive upon a quince-stock in a poor or gravelly soil.

Pear-trees planted either against walls, or in espaliers, must not be placed nearer to one another than twenty feet. Pear-trees commonly produce their blossom-buds first, at the extremity of their last year's shoots; the common way of pruning is very prejudicial, therefore, as it takes off the part which should bear the fruit, and occasions new shoots from the same branch, which will over-fill the tree with wood, the trees should always be carefully looked over in summer, and all the foreright shoots taken off; by which means the fruit will not be over-shaded, and the trees will need but little winter-pruning. The several sorts of summer pears all ripen best in espaliers, but the winter pears require a south-east or south-west, or else an east wall. *Miller.*

(a) All the species of plums have within their fruit a hard stone, within which there is contained a soft and tender kernel: this kernel contains the seminal plant, from which would be produced another tree of the same kind, if it were set in the ground; and it is very natural to suppose, that the only use of the thick stone or husk of this, was only to preserve its tender substance from rotting too soon in the earth, and to give it a proper time for developing its parts, to preserve its natural oiliness during that time, and to furnish from its

own

The earliest plum in *Franco* is called *cerifette*, or little cherry-plum; we have two sorts of it, one red, and the other white, which both part from the stone, like the damask-plum; and though these are wildings, they deserve a place in our gardens, being well tasted, and coming very forward; they are raised by off-sets, and from the stone; and without grafting come to bear very well.

2. *Prune de Catalogne*, i. e. the Catalonian plum, is large, white, and very forward, but does not leave the stone; it is a wilding, and bears well without grafting.

3. *Prune*
 own substance a proper nourishment to the growing plant; for observation shews, that it finally breaks into a very fine powder. There has not been found any species of plum which had not its kernel contained in a stony coat of this kind, from whatever grafts they have been propagated; nor is there any art known by which the kernel of this sort of fruit can, while growing, be deprived of its coat.

Mr. *Marchand*, however, in the year 1735, shewed before the Academy of Sciences at *Paris*, certain plums, whose kernels had no stone or shell round them; and found that they grew upon a tree which never had produced any others, and which had been known to produce such for twenty years. The kernel in these was covered with a reddish skin, which was rough to the touch; and within that, with another which was thinner and white. The kernel had nothing particular in it, except that it carried on one side of its outer surface, and that always in the same place, a little stony prominence, more or less dented on its convex part: this is usually a twelfth of an inch broad, and two thirds of an inch long, and has no other appearance but that of a distempered part of the kernel, only that all the kernels have it. The thick wrinkled skin which surrounds the kernel, seems in this case to supply the place of the stone or hard shell; and in this also it resembles it, that the pulp of the fruit parts easily and readily from it; and the hard oblong body, which is placed on one side of the kernel, is by no means proper for this purpose. *Mem. Acad. Scienc. Par. 1735.*

3. Prune de St Cyr, *i. e.* the St Cyr plum, is a black damask, and early ripe; it has a pleasant juice, and leaves the stone; it may be raised by suckers.

4. Gros damas noir hâtif, *i. e.* the great black early damask plum, leaves the stone dry; its flesh is yellow; and it is one of our best fruits; it must be grafted and planted against a wall, for in the open air it is subject to drop its fruit.

5. Le petit damas noir, *i. e.* the little black damask plum, is the next ripe; it is a great bearer, may be raised from suckers, or from the stone, and requires no grafting; it is every where allowed a good plum.

6. Prune de taureau, *i. e.* the bull-plum, or by some called poitron, is a large long fruit of a brownish red, but does not part from the stone; it bakes well, and makes good sweetmeats, however I cannot commend it to be eaten raw; as it comes early and bears well, we should not be without it.

7. Prune de damas d'Italie, *i. e.* the Italian damask plum, named by the *Italians*, bouboucone, is of a violet-colour, large, and early ripe; it leaves the stone, and has an excellent sweet juice; it is one of the best plums, and not very common; it is not subject to ruin.

8. Perdrigon de cernay, is also called the double damask and passévellours; this, through mistake, has been taken for that plum called prune de monsieur, but it is not; however, the fruit is fair and large, and of a fine violet-colour, well powdered, and comes early; the stone is large as well as the wood and leaf; it opens well, leaving the stone dry, but its flavour is none of the best, yet one cannot well be without it, being a great bearer.

9. Prunes de damas, *i. e.* the damask plums, are red, white, and of a violet-colour; they are all very good, leave the stone, and their juice is richly sugar-ed; the red and white damask are round and small, and the violet somewhat larger and longer.

10. Prune

10. Prune de brugnelle, *i. e.* the bruniolle plum, is a sort of perdrigon, whose flesh is yellow; it is good raw, dried, or in sweetmeat.

11. Prunes d'abricot, *i. e.* the apricot-plums, are of several sorts; the yellow, which is large and long, is not so good as the others, having a dry flesh; the red sort is larger, somewhat like the imperial plum; it has the taste of an apricot; and the white sort is large, round, and of an extraordinary rich flavour; I esteem it one of the best: all these leave the stone.

12. Prune diaprée, called in *England* the diaper plum, is of six sorts; first, the violet, which is long, and very much powdered, quits the stone, is early ripe, and one of our best plums; it bears well.

13. Diaprée rouge, *i. e.* the red diaper plum, is by some called Roche-carbon, from a village near *Tours*; it does not quit the stone, but is large, round, and extremely well tasted; it also dries well; if we propagate it from suckers, it bears abundantly, but if it is grafted, it brings larger fruit.

14. Diaprée blanche, *i. e.* the white diaper plum, is pretty large, greenish, of a sugared juice, and comes clean from the stone, like the violet diaper plum, whose flesh is green; but this has a yellow flesh, like the true diaper plum: there is another sort which we call the bastard diaper; it is of a violet-colour, and well dusted, but does not clear its stone so well as the rest; it is propagated by suckers. The long, red, early diaper plum is also very good; it brings double flowers, and is reckoned a curiosity.

15. Mirabelle is a small kind of white damask, which bears plentifully; it makes an excellent sweetmeat, having a musked flavour; it does better from suckers than by grafting: there is the large and the small mirabelle plum, both of the same goodness.

16. Drap d'or, *i. e.* the cloth of gold plum, is a yellow damask streaked with red; it leaves the stone,

is

is a fine fruit, very good, and of an excellent juice; I think it one of the best.

17. Prune de perdrigon, *i. e.* the perdrigon plum, is of four sorts; the white, which is large, and a little long, is a fine plum, either raw, or in sweetmeat; the red and violet kinds, which seldom leave the stone, are both in high esteem; their flesh is firm, and their juice extreamly rich; the sweetmeats made of them are very much in request, as well as the fruit without any art.

18. Perdrigon noir, *i. e.* the black perdrigon, is less than the others; it is a good bearer, but does not leave the stone; it has a fine and very singular flavour.

19. Perdrigon norman, is a pretty large plum, of a bluish red, very much powdered; it is a round fruit, but bears well.

20. Petit perdrigon violet tardif, *i. e.* the late little violet perdrigon, is almost round, leaves the stone, and bears well; it has a rich juice, and is eaten in *October*, and some time after.

21. Prune imperiale, *i. e.* the imperial plum, is of four sorts; the red kind is large, long, and very much powdered; it is an antient fruit, and very good; we cannot well have too many of them, for they dry very well in an oven, and are no less to be commended raw.

22. Imperiale blanche, *i. e.* the white imperial plum, is of the same bigness and length with the former, but not so good, being some years meally and dry.

23. Imperiale noir, *i. e.* the black imperial plum, comes late, and is a very good fruit; it comes clean from the stone, as well as the others of its tribe.

24. Imperiale tardive, *i. e.* the late imperial plum, is the biggest and the best; it is much powdered, and bears very well; it will last till towards the end of *October*.

25. Prune

25. *Prune royale*, i. e. the royal plum, is a large, fair, round plum, of a bright red; its stalk long, the fruit much powdered, and very well tasted; it is one of the best.

26. There are seven sorts of damask plums, which come later than the others, and are somewhat more rare; the first called *damas musquée*, i. e. the musked damask plum, is the same with the Cypress or Martha plum; it is black, and very much powdered, rather flat than round; its taste is particular and rich, and may be ranked among our first plums.

27. *Damas orange*, i. e. the orange-damask plum, is streaked with red, and is somewhat like the little mirabelle plum; so that some call it the red mirabelle, both having a stone much alike, that is, small, and of a longish make.

28. *Gros damas verd*, or the great green damask plum, is round, and always of a green colour, when it is ripe; it leaves the stone, is very fleshy, and has an extraordinary rich flavour. Q. Whether this is not the green gage plum in the *English* catalogue?

29. *Le petit damas verd*, or the small green damask plum, is a good bearer, and makes excellent sweetmeats; it is always green coloured when it is ripe.

30. *Damas gemelle*, i. e. the twin plum, is very much powdered, pretty large and long, and of a sweet water, the fruit always comes double; it is very rare.

31. *Damas blanc tardif*, the late white damask plum, is rather flat than round; its juice is very sweet, and it comes clean from the stone like the other damasks.

32. *Damas de'Espagne rouge*, or the red Spanish damask, is round, very much powdered and large; it quits the stone readily, but is not so high flavoured as the others: yet it is an admirable plum for bearing, and is very beautiful.

33. *Prune*

33. Prune de moyeu, *i. e.* the yolk of egg plum, is of two kinds, one comes from *Burgundy*, whose wood is thorny, and the fruit longish like an heart; yellow without and within; it is excellent in sweetmeat and marmelade, where its flavour is improved by the fire, coming near that of the apricot; but it is not very agreeable to be eaten raw, having a dry flesh, and a sharp juice like the other kind, called in *French* moyeu d'oeuf, because it is like the yolk of an egg; this sort is likewise round and yellow, and the flesh dry and tart; it is good in sweetmeats, but not so rich as the former; both these being wildings, bear abundantly.

34. The plum called prune damasquinée, is a kind of large white damask plum, streaked with red; it is rather long than round, very fleshy, and one of the fairest and best plums: it ripens pretty late.

35. Prune de Jerusalem, *i. e.* the Jerusalem plum, by some called the Bourdeaux plum, or l'oeil de bœuf, *i. e.* the ox-eye plum, is very large, of a brownish violet-colour, very much powdered, and unequal in its shape; it does not leave the stone, and is rather good to look at, than fit for eating raw.

36. Prune d'Ivert, *i. e.* the Ivert plum, is very long and narrow, makes good sweetmeats, and is always green; it does not part from the stone; there is also a red sort, which is not so much in esteem, because its flesh, which is yellow, grows red by stewing or baking.

37. Le cœur de bœuf, or the ox-heart plum, by some called prune de St Lo, is the largest of all; it comes clean from the stone; its flesh is very yellow, and its skin red; it is half as big, and as long again as the imperial plum, but its flesh is not so solid.

38. Le mangeron, is a fine large damask plum, of a violet-colour; the fruit is round, and opens well; the taste is particular, and much to be admired.

39. Prune

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39. Prune sans noyau, *i. e.* the plum without a stone, is black and small, and shaped like a heart; it opens well, but has only a kernel within-side; it is a rarity, but not very pleasant to eat.

40. Prune datille, is of two kinds, one brought from a place named *Gonorre*, and the other from *Maus*; the last sort is the white, long and narrow, the other is less, shorter, and of a violet-colour; they both open well, and are excellent in their taste.

41. Cœur de pigeon, *i. e.* the pigeon's heart plum, is so called from its shape; this sort is black, of a moderate size, and opens very well; it is well tasted, and is so much the more to be esteemed, because it keeps so long upon the tree, that is, from about the end of *September*, till the end of *October*; it is fit for eating, and is a very good bearer.

42. Prune de Rhodes, or the Rhodes plum, is fair and large, of a brown violet-colour, and very much dusted; it is somewhat longish, and opens pretty well; it ripens a little late.

43. Damas gris, or the grey damask, called also prune de monsieur, is a violet plum, very much powdered; it is pretty large, the flesh yellow, and quits the stone; it is well tasted, and is eaten late; some call it gros damas musquee tardif, *i. e.* the large late musked damask plum.

44. Prune transparente, *i. e.* transparent plum, so called, because if we hold it to the sun one may see through it, so as to discover the stone; it is very rare, and an handsome large fruit, long and white; it is very good, and parts from the stone.

45. Prune virginale, *i. e.* the virginal plum, is a sort of large white damask, very much esteemed in *Anjou*; it leaves the stone, and is one of the best plums; it is somewhat like the apricot-plum brought from *Tours*, but is a little whiter without and within.

46. Mignonne, *i. e.* the minion plum, is pretty large and long, white streaked with red, and opens well;

well; its flesh is delicate, and its water very sweet; it is highly esteemed about *Touraine* in *France*, where it gained the name *mignonne*, or favourite, for its good qualities; it bears very well, and holds a long time ripe upon the tree.

47. *Reine Claude*, or *Queen Claudia* plum, is a sort of large white damask, almost round; it ripens pretty late, and its flesh is firm and thick; it quits the stone, and its juice is richly sugared; it is highly esteemed.

48. *Prune de Pologne*, or the *Polonian* plum, is white, large and longish; it opens well, and is very good; it is somewhat like the white imperial, but much better.

49. *Prune de Suisse*, *i. e.* the *Switzer's* plum, by some called *l'altesse*, is in form like the imperial, but longer, and a little more pointed; it is of a violet-colour, and very much powdered; it leaves the stone, comes late, and yet ripens well.

50. There is also another *Polonian* plum, of a violet-colour, very much powdered, pretty large and long, almost shaped like the *St Catherine*; the flesh is yellow and very well tasted, though it is one of the latest plums.

51. *La prune date*, or the *date* plum, is a sort of late imperial; there is the white and the red; they open well, and keep a long time ripe upon the tree, and after they are gathered; the flesh is very firm, and is good raw or dried.

52. *Prune de St Catherine*, *i. e.* *St Catherine's* plum, is white, large, and more flat than long; it rarely leaves the stone, but is very good to eat raw, being one of those which has the sweetest juice, although it ripens late; it dries very well, and without much trouble, being subject to dry even upon the tree; this sort comes better from a sucker than by grafting: we should have a good many of them.

Z

53. *Damas*

53. Damas d'Espagne, *i. e.* the Spanish damask plum, is of two kinds; one is quite round, and the other a little longish; they are both black, and come very late, but they open well, and are very good.

54. Rognon de coq, *i. e.* the cock's kidney, is a small white plum, streaked with red, a little longish, and shaped like a kidney, but it cleaves to the stone, and comes late; it is a great bearer.

55. Prune de St Julian, or the St Julian plum, is of a dark violet-colour, very much dusted; this does not quit the stone, and dries upon the tree, and sometimes remains there till the hard frosts begin; it is a good plum, and comes from a wilding.

56. Prune Norbette, *i. e.* the Norbet plum, is like one of the late small damask plums, which does not part from the stone; it eats well raw, but bakes much better; it makes excellent pruants of a fine blue colour.

57. Diaprée noir tardive, or the late black diaper plum, is an excellent fruit, a little rounder than the early sort; it is eaten in *October* and *November*.

58. Gros damas violet tardif, *i. e.* the late large violet damask plum, comes from *Tours*, is a very good fruit, and leaves the stone; it ripens late.

59. Gros damas rouge de Tours, *i. e.* the great red damask plum, brought from *Tours* in *France*, ripens its fruit late; it leaves the stone, and is very well tasted; this holds in eating among the last plums.

60. L'imperatrice, or the empress, is a large, round, damask plum, of a violet-colour, very much powdered; it is a good bearer, its flesh is yellow, and very agreeable; it is one of the latest ripe.

61. Perdrigon nantais, is a large red damask that comes late; it is of a long make like the date plum, but less pointed; I reckon it one of the best, and it keeps upon the tree till the great frosts.

62. Gros damas violet, the large violet damask plum, is a long fruit, well powdered; it is much in esteem

esteem for its goodness, it is lasting and bearing. By the powdering and dust of a plum, is meant what the *English* gardeners call the blue of a plum.

63. Prune supreme, the supreme plum, is one of the largest, and is white streaked with red, of a long make, and comes late; the leaf is extremely large: this fruit does not part freely from the stone, and, in my opinion, is rather to be chosen for its beauty than its goodness.

64. Le gros damas noir tres tardif, or the latest great black damask plum, does not part freely from the stone, nor is it so high flavoured as the former plums; however, we should have some of this sort, as the fruit is beautiful and lasts a great while.

One might yet mention great varieties of plums, which are frequent enough about *Paris*, but I shall content myself with those already mentioned, which will furnish a sufficient variety for any garden of the best sorts (b).

CHAP.

(b) All the sorts of plums are propagated by budding, or grafting them upon stocks of the muske-plum, the white pear-plum, the St Julian, or the bonum magnum. Budding is much properer than grafting for these trees, as they are apt to throw out a great deal of gum from the wound: and the trees should be no more than one year's growth from the bud, when they are transplanted; for if they are more they seldom succeed well, being very subject to canker; and if they escape that, they usually produce only two or three luxuriant branches. The whole management of planting and pruning them is the same with that of peaches. (*The treatment of which may be seen in the next chapter.*) If the walls against which they are planted are low, they should be set eighteen feet asunder; if they are higher, then fourteen or sixteen. Plums should have a middling soil, for they seldom succeed well either in too moist or too dry a one; and when planted against walls, should have an east or a south-east prospect. If they have one at full south, they are apt to shrivel up, and turn mealy. Plums in general succeed very well with proper care on espaliers, they will also bear very well

CHAP. V. *Of peaches; a catalogue of the best sorts, with their descriptions and times of ripening, with several useful particulars relating to their improvement.*

AS the peach is one of the most delicious fruits of the garden, if it be well known, and managed with discretion, it is worth our while to inquire into the several varieties of it, and then examine into their several ways of management. The list of the several sorts here mentioned, will be those which are accounted the best in *France*, which amount to a good number; however, a large garden should not be without them all, forasmuch as they ripen at several seasons, beginning about the middle of *June*, and affording fruit till *November*; but where a garden is small, the owner may choose his fruit out of the following list, and please his taste by examining the descriptions of every sort.

The earliest sort is that called *l'avant pesche musquée*, the early or avant musked peach; the fruit is small and white, but its water or juice very sweet; it is a great bearer, and is very subject to be invaded by pismires.

The second is called *la pesche de Troye*, or the Troy peach, which ripens at the same time with the former; it is called in some places *avant pesche musquée rouge*, or the early red musked peach; it is larger and higher flavoured than the white sort.

3. *La*

as standards, but the fruit will not be so well tasted. Plums do not only produce their fruit on the last year's wood, but also on spurs that come out of the wood of two or three years old. It is a common error to be too free with the knife in the winter-pruning, cutting off the extremities of all the branches; the consequence of which is, that there are an over-quantity of young shoots produced, and the fruit is small and poor. *Miller.*

3. La double de Troye, *i. e.* the double Troy peach, is larger and rounder than the former, and as well tasted; it is a great bearer, and holds some time good upon the tree; there are two kinds of this peach, the one red, the other of a brownish purple.

4. La pesche capucine, or the capucine peach, is early, and esteemed for being pretty large and very well tasted; it is a little longish in its make; it was raised from the stone of an early peach, and is so changed in its fruit, that it exceeds them all; a change of this kind I find common to peaches raised from the stone; the stone of a peach sometimes bringing a pavy, and the stone of a pavy producing a plant which brings a peach. Note, the pavies are hard fleshed, and the peaches are melting.

5. L'alberge, or, in the *English* catalogue, the alberge peach, is yellow within and without, of a middle size, excellent rich flavour, a little flat, its stone small, and covered with a reddish purple.

6. L'alberge rouge, or the red alberge, has a white flesh, is flatter than the former, and not so well tasted.

7. L'alberge violette, *i. e.* the purple alberge peach, is rarer than the two preceding; its colour is a brownish purple; the fruit is somewhat small, and is not so good as the yellow, which is an excellent peach.

8. La pesche Magdalaine, or the white Magdalen peach, brings a very large fruit in good ground, but is seldom marked with red; it is one of the best peaches we have in the garden, being full of an high flavoured juice, which melts freely in the mouth; it is subject to drop its fruit, and is often invaded by the pismire, as most of the high tasted fruits are. There is one of this sort which is called the musked Magdalen, which has a richer flavour than the rest. It is proper to observe that these trees blossom early, and should be sheltered from the rudeness of the weather while they are in flowers, if we expect a good crop.

9. La Magdalaine rouge, or the red Magdalen peach, is not so large as the former, but the flesh or pulp is rather more delicious; it is a better bearer than the other Magdalen peaches.

Memorandum. There is not one of these peaches which would not ripen without a wall, and might not be brought to bear upon standards, though the shaking of the winds would, perhaps, be apt to make them drop their fruit; but if they were to be trained in the manner Mr *Heron* has mentioned in relation to pears, in his letter to me inserted in this *General Treatise* (a), that is, by placing arbour poles in such a manner, as to form the shape of a bell the wrong side uppermost, and by twisting the young shoots of the tree about such a frame like a screw, I am apt to think we might keep our peach-tree full of wood every where; in that case there would be no necessity of pruning, which is too apt to bring gum, and to canker the trees to their destruction in stone-fruits. If reason can guide us, this contrivance must be good, for all stone-fruit trees are apt to gum, by pruning and wounding them; and the more a tree gums, the sooner it decays: but in this screw-like winding of trees, there need be no pruning, and consequently those which bring stone-fruit may last long.

The tenth peach, called by the *French*, la pêche mignonne, or the minion peach, and by some de France la veloutée, or the velvet-peach, is of the Magdalen-kind, it is rather flat than round, pretty large, and well coloured within and without; it is very juicy and well tasted, and is esteemed one of the best peaches.

11. Le pavy blanc, i. e. the white pavy, is said to be the male of the Magdalen race; it is high flavoured and musked, and as it comes among the first peaches, it ripens easily: we have likewise the red

(a) See this letter from Mr *Heron* to our author inserted in Chapter 9. following.

and yellow paves, which are for eating at the same time : it is the opinion of curious men, that every peach has its pavy, which is supposed in *France* to be the male-peach.

12. La pesche cerise, i. e. the cherry-peach, is red, and the flesh a little dry and hard; it is not one of the best.

13. La pesche royale, i. e. the royal-peach, brings a fair fruit, of a fine red colour; it is rather long than round, but has little juice.

14. La belle chevreuse, is of a bright red colour, and has a delicate sweet juice; the fruit is longish and pretty large; it bears very well, and has several varieties in its tribe.

15. La pesche d'Italie, i. e. the Italian peach, is a sort of chevreuse, a little larger than the former; it has some qualities of the peach, which the *French* call la pesche de peau, but is a little more pointed; it is an excellent fruit.

16. La pesche chancelire, i. e. the chancellor-peach, is of the chevreuse family, and is the largest and best of them all: it has been brought to bear and ripen fruit very well upon standards in the Chancellor *Seguier's* gardens in *France*, from whence it took its birth from a stone of the common chevreuse peach.

17. La pesche dreusel, is rather long than round; its skin is velveted and well coloured, and dry, but very agreeable; its flesh or pulp is almost red, from whence it is called in *France*, sanguinole, or the bloody peach.

18. Pesche bourdin, is a round fleshy fruit, pretty red, and of a middle size; it has a very rich flavour, much like that of the Persian peach; it is well esteemed, is a great bearer, and brings better fruit in standards or dwarfs, than against a wall.

19. Pesche violette, i. e. the violet-peach, is rather long than round, very melting, and its juice of a vinous flavour; it bears well, either against a wall or

in a dwarf, and is esteemed one of the best; there is a large and a small sort.

20. La pesche blanche, or the white peach, is a good fruit, but not so well flavoured as the violet-peach; the tree is very tender, and should be carefully looked after: this peach has its pavy, which is a

21. White brugnion, finely spotted with red; this sort is much improved if it lies by some time before it is eaten, its flesh then becomes tender and melting; it comes late, but is very good.

22. La pesche licée jaune, or the yellow rough coated peach, is pretty large and flat; and though it comes late, its flesh is good and juicy enough.

23. Pesche violette tardive, or the late violet-peach, is large and fair, and is well tasted when the autumn is dry; it ripens so late in *October*, that when the season is wet, it is worth little; it should always be planted against a south wall.

All the rough coated peaches have their males, which are called by the *French* brugnions or brunions: these are rounder, larger, and have their juice more musked and perfumed; their flesh is firm and a little hard, and therefore they require a great deal of sun; but none of the brunions are so much esteemed as their peaches, because they do not quit the stone.

24. Le teton de Venus, *i. e.* Venus's breast, is not unlike the admiral; it has some resemblance of a woman's breast, pointed on the top like a nipple; its flesh is white, and without-side it is a little touched with red; it is melting and high flavoured, and is one of the best late peaches.

25. Pesche commune, or the common-peach, is by some *French* gardeners called pesche de corbeille, *i. e.* the basket-peach; it is round, very white, and velveted; it is a bastard magdalen raised from a stone; it is very well tasted in light ground, but in the strong lands its flesh is green and bitter; it is a great bearer, and will come to perfection without the help of a wall.

26. Pesche

26. *Pesche a fleur double*, *i. e.* the double blossom-peach, is rather a curiosity than a good peach, and more coveted for the sake of its flower than for its fruit; the fruit indeed is large and fair, but it seldom bears.

27. *Pesche admirable*, is what we call in *England* the admirable; it has that name, as well for its beauty and goodness, as for its large fruit; it is almost round and very red, and its flesh very melting and well tasted; it is very much esteemed, and one can hardly have too many trees of it.

28. *Pesche pourprée*, *i. e.* the purple-peach, or by some called *nivette*, is large, and almost round, of a brownish red, and velvety, very fleshy and well tasted; it is one of the best bearers and best peaches.

29. *Pesche d'andilly*, *i. e.* the andilly-peach, is very large, round and fleshy; it is white within, and without, somewhat like the Persian peach.

30. *La Persique*, *i. e.* the Persian peach, is very large, but shorter and rounder than that which is called *pesche de peau*, *i. e.* the skin-peach; it is red and pointed, and its fruit is commonly blistered or knotted on the outside; its flesh is delicate and full of juice, very red towards the stone, which is flat, and sharp-pointed; it bears well either in standard or against a wall, and well deserves a place among our best peaches.

31. *Pesche d'abricot*, *i. e.* the apricot-peach, is by some called the Scandalian peach; we have two sorts of it, both round, one smooth and velvety, and of a reddish colour, the other rougher coated and yellow; they bear and ripen well either in dwarfs or standards, and may be raised from the stone.

32. *Pesche Bellegarde*, or the Bellegard-peach, of the *English* catalogues, is a fair, large and round fruit, and has very little red within or without; it is a good peach and comes a little late.

33. *Pesche*

33. *Pesche Narbonne*, or the *Narbonne-peach*, is very large and greenish, its flesh is a little dry and cottony, rather to be esteemed for coming late, than for its goodness.

34. *Pesche Rossane*, or the *Rossane-peach*, is much esteemed in *Languedoc*; it is yellow within and without, the flesh is a little dry, and not very high flavoured about *Paris*; the fruit is long, large, and comes late.

All the peaches which are yellow within and without are less esteemed than the others, having a drier flesh, and a less perfumed juice.

35. *Belle de vitry*, is a very large peach, flat, fleshy, and full of knobs; it is a very good late peach; it is juicy, rich, and red towards the stone, which is very small; it is so like the *nivette-peach*, that some gardeners would have it the same; but I am of opinion it is the female of the great white monstrous pavy, which is not unlike it, and comes at the same time; it is almost round like the admirable, which is white within and without, but the *belle de vitry* is of a brownish red, and velveted.

36. *Pesche de peau*, *i. e.* the *skin-peach*, is of two sorts, *viz.* the round kind, which is a good peach, and the best of the two; and the long sort which is flat, and subject to decay in the middle, its stone splitting for the most part; it requires a warm exposure, otherwise its fruit is green and tasteless; the male of this sort is very large, and is called the monstrous pavy, which brings a fine red fruit, full of flesh, and requires the warmest exposure to bring its fruit to perfection.

There are still many other tribes of peaches, as those that bear the title of *presse*, of which there are white, red and yellow. The *mericotoues* or *malacotoues*, &c. which I shall not particularly take notice of, no more than of some pavyes, that will not ripen

in

in the colder climates, that is, where the sun is not very hot in *October*, which is necessary to soften the flesh of the paves, which are too apt to be hard (b).

C H A P.

(b) The fineness of this fruit, in general, depends on the firmness of the pulp, the delicacy of the flavour, and the thinness of the skin: A fine peach should be of a fine deep red next the sun, and of a pale whitish hue next the wall; and the pulp should be of a yellowish cast, and very juicy; and the stone should be small, though the fruit in general be large. The varieties of the peach are produced like those of the finer flowers, by sowing the seeds; and though many raised this way will be of little value, as is also the case in flowers, yet probably among a parcel of stones, saved from the finer kinds of peaches, there would be some new kinds produced; which, as they were raised here, would be easily kept up in their perfection; which is not to be expected of those brought from other countries.

The best method of saving the stones is, to let some of the finest peaches of the best kinds hang till they drop of themselves from the tree, and then the stones should be immediately planted on a bed of light rich earth, planting them four inches deep in the earth, and at about six inches asunder. The beds should be covered, to preserve them in the winter; and in spring, when the trees come up, they must be cleared of weeds, and well watered. The next spring they should be carefully taken up, and planted in the nursery, at greater distances; and after two or three years standing here, they may be removed to the places where they are to remain; or they may at that time, when the condition of their fruit is known, be grafted on other stocks, which is the common way now used to propagate these trees.

The common method of propagating the peach is, by grafting. In order to this, some good stocks should be provided, which should be of the muscle, or white pear-plum. When these stocks are two or three years old, they will be strong enough to bud; and the common season for doing this is about midsummer. The buds should be chosen from a healthy tree, which produces a great deal of fruit; they must be taken from the trees either in a cloudy day, or else in the morning or evening, when the sun has not much power; they should be then inoculated on the stocks as soon as possible.

CHAP. VI. *Of the hazle and mulberry, with remarks upon their management and improvement; together with particular proofs of the sap's circulation in plants.*

I Have observed five kinds of hazles, which may properly enough be cultivated about a country-house, and it is as likely there may be as many more that has slipped my observation: however, if any one knows

file, and the stocks treated with the usual care afterwards. When these are to be transplanted where they are to remain, the most proper soil for them is, a light rich pasture-land, taken up with the turf, and rotted together, before it is to be used; and the borders to be made with this cannot be too wide, and ought to be raised five or six inches above the level of the ground; or if the soil be moist, more than that. They must be transplanted in autumn, as soon as the leaves are fallen off; and should never be set at less than fourteen feet distance from one another. The heads of the trees are then to be raised up against the walls, to keep the roots from being moved by the wind; and they should be watered at times, with a nose on the wateringpot, and the water sprinkled all over them. In the middle of *May* the new shoots are to be nailed to the wall, training them horizontally; and the foreright shoots are to be rubbed off: in *October* the new branches should be pruned, shortening them according to the strength of the tree; if strong, they may be left eight inches long; if weak, they should only be left five; and the same care is to be taken of them for the succeeding years.

There are two general rules always to be observed in the pruning of peach and nectarine trees, which are, 1. Always to have enough bearing wood. And 2. Not to lay in the branches too close to one another. All peach trees produce their fruit from the young wood either of the same, or at the most, of the former year's shoot; for this reason, the branches are to be so pruned, as to encourage them to throw out new shoots in every part of the tree; and this is to be done in
May;

knows how to manage these, he needs no instructions for the culture of the rest, because they are all so nearly allied, that their management is the same, unless in this particular, that the *Spanish* and *English* hazles will bear well in a coppice, and the filberts and cobnut must have air to bring a tolerable crop; the sorts are these. The red filbert, best white filbert, good *Spanish* hazle, good cobnut, and the very large common hazle; all these may be grafted upon one another, and the seedlings bring nuts of various kinds.

The red filbert is esteemed more than the others; its kernel is tender, and the shell very thin; this and the white filbert bring their nuts in clusters, even sometimes to the number of twelve in a bunch.

The cobnut brings the largest nuts of any of the hazles, but its shell is very hard as well as its kernel, and is chiefly esteemed for its extraordinary size; however, some delight to propagate it; and with seven years patience it may be brought to bear from a nut set in the ground, as well as the *Spanish* nut, which comes as well with us as the filbert; but what kind

May; when by pinching, or stopping the strong shoots, there may be new wood forced out in any part of the tree. This is the method of the summer pruning; the winter pruning is usually done in *February* or *March*, but is much better done at *Michaelmas*, as soon as their leaves begin to fall; and the wounds will then have time to heal before the severe frosts come on. In pruning of these trees it must always be observed also, that it is best done under a wood bud, not a blossom bud; which may be distinguished by the wood buds being less turgid and longer, and narrower than the blossom bud; for if the shoot have not a leading bud where it is cut, it will commonly die down to the leading bud. In nailing the shoots to the wall, they should be placed at as equal distances as possible; and so far apart that the leaves may have room; and they must always be trained as horizontally as possible, that the lower part of the tree may be well wooded, which it will not be if the branches are suffered to run upright. *Miller.*

kind soever we like best, may with very little trouble be increased by grafting upon the common hazles, upon which it takes freely, so that in hedge-rows, and other open places, where we have common hazle, we may presently make an amendment; it would be well to try some in coppices (a).

Observations concerning the mulberry. The black mulberry tree should be planted in the shade, to prevent its fruit from falling, which it is very apt to do if it be full exposed to the sun; it has been observed in some places, that this fruit comes extraordinary large, if it be planted and treated in espalier against a wall situated to the north.

The white mulberry brings a small fruit not worth our care, but the use of its leaves for silk-worms is very advantageous. A friend of mine tells me, that they may both be inoculated upon the elm with good success; it is worth our trial, considering the slow growth of the black sort; nay, he says, the buds will take upon the lime or linden-tree, and bear better than upon the elm; he advises the experiment to be made; and the expence cannot be very great (b).

Particular

(a) All these sorts of hazles may be propagated by sowing their nuts in *February*, which, in order to preserve them good, should be kept in sand, in a moist cellar, where the vermin cannot come at them to destroy them; nor should the external air be excluded from them, which would occasion their growing mouldy. The manner of sowing the seeds, being well known to every one, need not be mentioned, especially since it is not the surest way to obtain the sorts desired: for they seldom prove so good as the nuts which were sown, or at least not one in four of them will; and the method of propagating them by layers, being not only the surest but the most expeditious, is what I would recommend to every one who would cultivate these trees for the sake of their fruits.

Miller.

(b) The black mulberry is very common in most gardens, being planted for the delicacy of its fruit; it may be propagated

Particular proofs of the sap's circulation in plants.
The relation which I design at present is of a lime-tree in *Holland*, which is now growing with its first roots

gated by sowing the seeds, or by laying down the tender branches, which in two years will take root, and may then be transplanted to the places where they are to remain. Those plants which are propagated from seeds are commonly the most vigorous, and generally make the straightest stems: but then there is a very great hazard of their being fruitful: for it often happens that those plants for the most part are of the male kind, which produce katkins, but seldom have much fruit: but as the trees raised by layers are subject to have crooked unsightly stems, there should be care taken in the choice of straight shoots to make layers, and when they are transplanted out, they should have straight stalks fixed down by each, to which they should be fastened as the shoot is extended, until it comes to the height you design the stem: then you may suffer the branches to extend as they seem inclinable, for this tree should not be often pruned, but only such branches should be cut off which shoot cross, and bruise themselves by cutting against each other, and such as decay should also be cut off.

This tree delights in a light soil, not too wet nor over dry, and should have an open exposure. The soil under this tree should also be every year well dug and manured, though there will scarce any sort of plants grow under it.

The white mulberry tree is commonly planted for its leaves to feed Silk-worms in *France*, *Italy*, &c. though the *Persians* always make use of the common black mulberry for that purpose. The trees which are designed to feed Silk-worms should never be suffered to grow tall, but rather kept in a sort of hedge, and instead of pulling off the leaves singly, they should be sheared off together with their young branches.

The white sort may be either propagated from seeds or layers as the black mulberry, and is equally hardy: but the most expeditious way of raising these trees in quantity is from seeds procured from the south of *France* or *Italy*; and the best way to sow these seeds in *England* is to make a moderate hot bed, which should be arched over with hoops and covered with mats: upon this bed the seeds should be sown in the middle of *March* and covered over with light earth about a quarter

in the air: these have shot out branches in great plenty, at the same time that its first branches at the head are converted into roots, and succour the tree: I then desire to know, if the sap is not every where at once in the same tree? and whether all the sap of that tree has not the same intent towards vegetation? Those, who say the sap is in the root all the winter, seem, from this instance, to be mistaken; and if it was not every where alike in the tree, how comes it that the branched part of the tree exchanges its leaves for roots, and the roots that were before, change their fibres for leaves and branches? Is it then not plain, that the sap is the same in every part of the tree at all times, and is constantly acting equally throughout the whole plant?

But that we may not go so far as *Leyden* for a proof of this relation, Mr *Fairchild*, Mr *Whitmill*, and some others, have began to put in practice the proper method for giving us some examples of it at home, and that those who are too remote from these gardens may not want the benefit of satisfying themselves at an easy rate, I shall here lay down two or three ways of performing the operation.

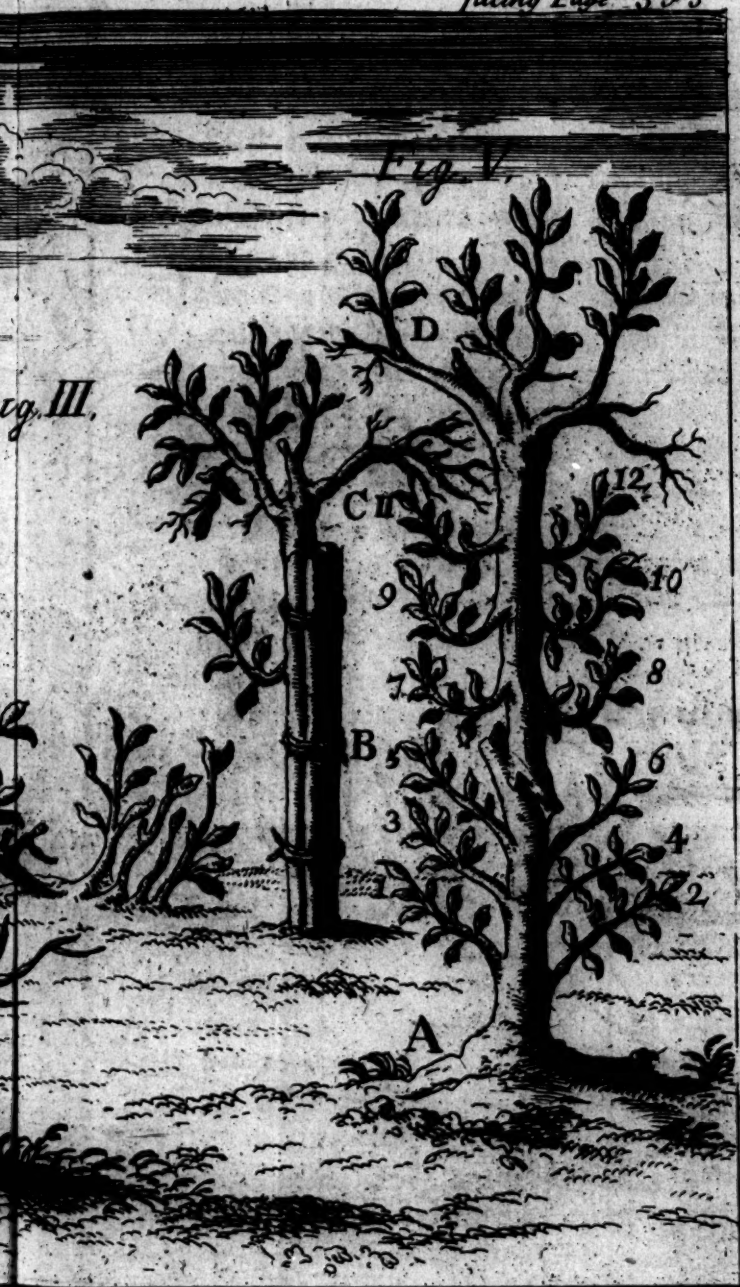
We must first make choice of a young tree of one shoot, either of willow, alder, elm, lime or linden, or indeed any other tree that will take root easily by laying, and bending the shoot gently down to the earth; we must pin down the extream part of the shoot in the earth at the proper season for making layers, and let it remain without any further trouble till it has taken root; your whole plant will then make the appearance of an arch or bent bow above the ground; till the new roots are well struck; then we must dig about the original or first root of the plant, and

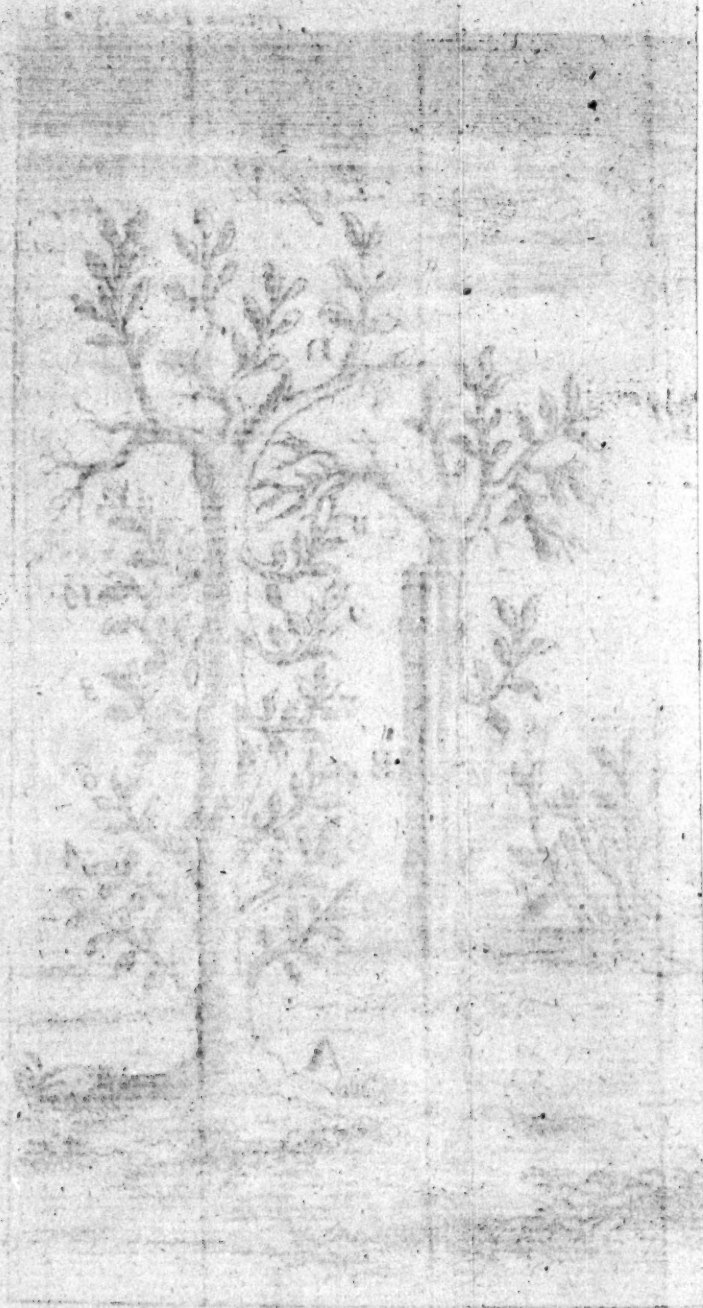
quarter of an inch deep. In very dry weather the bed should be frequently watered, and in the heat of the day shaded with mats, and also covered in the nights when they are cold.

Miller.









and gently raise it out of the ground till we bring the stem to which it adheres to an upright, which must be helped by a strong stake, for the stem alone will incline to bend.

When this is done, we must prune those roots that are raised into the air from the bruises and wounds they received in digging them up, and apply some of the following mixture warm with a brush to the pruned parts.

Take two ounces of bees wax, two ounces of tallow, one ounce of turpentine, one ounce of rosin, melt them together in a pipkin, and apply the mixture moderately warm, as directed before.

The tree being thus dressed, prune off all the buds or shoots that you can find upon the stem of the plant, and dress the wounds with the above mixture, to prevent any collateral shootings that may happen, which might thereby render the stem disagreeable to the sight; besides, were the stems of these reversed trees to be suffered to shoot collaterally, the original root, which we now have brought into the air, would not be so apt to shoot freely.

On the other hand, we must take care that the new growing roots of this reversed plant be well nourished, and therefore we must cut away that part of the shoot which was the layer, a little below the earth, to give the better nourishment to the stem and its translating roots; but when we have cut off the top of this layer, let the wound be dressed with the mixture beforementioned.

Plate X. Fig. I. is the tree in its natural growth. *Fig. II.* is the same tree bent down for laying the top branches in the earth. *Fig. III.* is a view of the same tree when its original root is brought into air after it is dressed, and begins to shoot.

When we are come thus far, we might rather expect wild shoots from the original roots, than such as would bear fruit, if we were to serve a grafted fruit-

tree after the same manner; for the graft could not communicate in the reversed way any more of its properties, than a wilding could to a graft in the common way of ordering trees; but it is not impossible to graft the original roots which are in the air, with any cion of the same tribe, no more than to do the same work upon common shoots of a tree, as I have experienced.

From the same way of reasoning, I conclude, that we might inarch two trees into one another, in such a manner, that where they had taken good hold of each other, the root of one of them might be taken out of the ground and raised into the air, so as to make one erect tree. For example, if we inlay an elm into an elm, as in *Fig. IV.* when they are well joined, take the root of one of them out of the earth, and tie it to a pole or stake, as in *Fig. V.* and I suppose it will have an extraordinary effect; but I cannot yet determine its success but by reason only.

If this succeeds, as I doubt not but it will, we shall not want room for speculation, how far the earth, or how much the air influences a plant (*c*). In *Fig. V.* from A to B, I suppose, from what I have observed in nature, that the shoots 1, 2, 3, 4, 5, 6, will be gradually less than one another. As for example, 1 the longest and thickest, 2 a size less than 1, 3 a size less than 2, and so on to B, where the two trees are joined; for as the stem from A to B does naturally decline in its bigness, so it does not possess so many vessels on the top as at the bottom. And again, the sap-vessels near the root are sooner and better furnished, than those that lie more remote from it. But when we come to the joining of the two plants at B, and go up gradually to C, we shall find just the reverse of what we observed before; the branch 7, I suppose, will be the least, 8 bigger than 7, 9 bigger than 8, and so on to the top. (c) See Introduction to Part I.

than 8, and so on to the part which acted before as a root. And again, all the branches from B to C will be obliged to turn up to the air, though their buds were reversed; and so it is as natural for me to suppose, that the root D will shoot out branches and leaves, as that in *Fig III.* which we have already an instance of in *Holland (d).*

This last experiment has been tried since the first impression of this work, and succeeds very well.

CHAP. VII. *Concerning the propagating and hardening of exotic plants and fruits by grafting, in a letter communicated by Mr Fairchild from a gentleman in Surry; to which is added, several useful remarks upon inarching, grafting and budding.*

Mr Fairchild,

I Write you this, to claim your promise of trying any experiments that I shall direct you in writing. But I will not treat the most rational gardener I have ever met with, in the same manner I would an ordinary one: nor shall I content myself with barely directing what I would have tried; but shall also explain to you the reasons I go upon, and the end I propose by such like experiments. You know I have been some years propagating and collecting all the several species and variations of trees, both *English* and foreign, that I can any where procure, and make to live abroad with me in the winter; the pleasure and usefulness of which I need not explain to you. I was last summer considering of the several ways of raising and propagating trees; and particularly by uniting them together, whether by grafting in the cleft, in the bark, by application to the side, (which I think you call whip-grafting) and that either by inarching, by

A a 2

application

III (d) See Introduction to Part II.

application to the side, or a top in the cleft, (as was practised by the antients) or inoculating, or budding. As to the method of grafting by incision, I do not know what to think of that, as it only rests on the authority of a *Rosicrucian* philosopher. First then, I observed, that it was a maxim received among you gardeners, founded on experience, that trees of the same genus or family might be united together (a truth that was very well known to the antient gardeners) and by observing particular instances, I found that those of the more general genuses, or remoter kindred, would do upon one another also; and that for instance, not only all sorts of peaches and apples would do upon one another, but that peaches too would take upon almost any sort of plums; pears upon quinces as well as pears, and even on the white-thorn and the quick-beam; almonds upon all sorts of plums as well as peaches, and some say on the white-thorn; medlars and azaroles on one another; and upon the quince, the white-thorn and the pear. I observed the same to hold likewise in forest-trees; and that the ashes, for example, would do upon one another, and so would the oaks; nor would the one's being ever-green, and the other not, alter the case, as you shewed me in the experiment of the live oak of *Virginia*, grafted upon the common oak. From these observations I concluded, that several exotic-trees that were hard to propagate, might have stocks found them whereupon they would grow, and particularly, I recommend the turpentine tree (which you complained you could not propagate) to be grafted upon the pistachia, which you say did take, but went off again, doubtless, because your stock was too small (the pistachia being very pithy when it is small). I hope when your stocks are a little bigger, it will have the desired effect, because *Tournefort* ranks them both under the same genus, and the antients used to graft the pistachia on the turpentine to meliorate the fruit. I hope you

(see Introduction to Part II.) will

will go on trying other things, even where the alliance appears remote, being warranted by the experiments abovementioned; and so we may in time see how far this matter will go. Though I know very well that you and others have tried to make trees take one upon another, that have no similitude in the flower, fruit, seed-vessel, or seed, which are the most natural distinctions of plants, and have met with no success in your trials; yet because some antients of credit have assured us, that the pomegranate and carob may be grafted on the willow; I beg of you to try them during this season: that tree may have some hidden relation to them, though not in its seed-vessel or fruit; or may have some other peculiar qualification for uniting with them, and if they do join, it may lead us to other things: these were the first thoughts that occurred to me in this matter.

Then I observed further that the grafted tree partook somewhat of the stock it was grafted upon; that the pear, for example, grafted on the pear, was a larger tree than one grafted on the quince: and I considered particularly the almond, which Mr Ray says in his time seldom produced ripe fruit with us, as wanting a warmer climate. But it is very well known, that since the Jordain almonds have been grafted upon plum-stocks, they bear very well in *England*; this made me suspect, that a hardy stock might harden a tender graft; but being unwilling to build too much on one single experiment, I desired you last summer to make trials in that way. And as the truth of this is plainly confirmed this season in your garden, by the flourishing appearance of the Canary-almonds grafted on the plum, while the seedlings of the same species of five or six years growth appear all nipped and shrivelled, notwithstanding the mildness of the winter; we are no longer now to doubt, but tender trees are to be hardened, to some degree at least, by hardy stocks. How far this matter may be carried,

can only be determined by experiments, which, I am sure, are well worth the making, considering the advantage and pleasure it seems to promise, by bringing new fruit-trees into our gardens and orchards, and new forest-trees into our wildernesses and thickets; and above all, new means of contemplating the wisdom and goodness of God, the noblest end of all philosophy: but all we can reasonably depend upon in this matter, is to have trees of the same degree of tenderness with those abovementioned, hardened, as they are, by the like kind of stocks. Thus, for example, as the pistachia in some years, and in some exposures, will bear fruit with us abroad, could we find a proper stock for it, why should it not be brought to bear as well with us as the grafted almond doth? And I shall be glad to see it tried on the hazle and on the plum. The antients say, it did with them on the almonds; if that be true, I think it must do on the plum too: and pray let us try it on the walnut also. The like almost might be expected from the olive, could we find a proper stock for it: I am afraid the plum is too remote; but perhaps it will take as well with us on the oleaster, as it did with the antients, and the oleaster is hardy. Why should not a hardy stock bring our tenderest figs to ripen as well in standards, as they do now against a wall? Perhaps the true or fruit-sycamore would be a good stock for them; and as that bears a fruit between a fig and a mulberry, it will itself perhaps take on the mulberry, and so by consequence would the fig, which I shall be glad to see tried. The *Greek* gardeners say it succeeded with them; and might not some sort of early ripe plums be probably found to make the later peaches, apricots and nectarines bear as well in standards, as the Brussels apricot does, which, I think, bears on one sort to perfection, though, probably, from another cause? For this, and other purposes, I am now collecting all the sorts of plums I can get; as I hope to do another season

the

the pears and apples. For the like may be expected too of the tenderer pears. And may there not possibly be found some small sorts of plums and pears, that may accelerate and meliorate those fruits, as the Paradise stocks do the apples? Thus far the analogy goes, and nature is uniform. But let us not stick here, though the experiment of the *Spanish* jessamine grafted on the *English* one, may seem to discourage us, the effect of a more compact and woody stock may be very different; however, let us not refuse to go as far as we can, if we cannot go as far as we would. Let us proceed therefore to try what nature will bear: and first, I desire you to graft and inarch the orange-citron and lemon on the apple, especially the Paradise (and if you please, on the quince and the pear): both those fruits are round and juicy, and include callos kernels of much the same shape; and, I think, are much more alike, than the haw and the pear, or the almond and the plum. Pray try likewise the pomegranate on the apple, quince, and pear; and so likewise might we the papaw and calabash-tree, if we had them; and the *Malabar*-plum, the *West-Indian* broadleaf, the soap-tree, the mixis, the jujubes, and the mango would, probably, do upon the plum. The azedarach from the similitude of its flower, according to the system of *Tournefort*, might be tried on the maple; and according to Mr *Ray*'s system, on the plum, from the likeness of its fruit; and so might the nutmeg and the cinnamon on the plum, or the walnut; the cassia fistulosa, and the tamarind on the common acacia, as they are all three siliquiferous plants: but I am afraid few or none of these are now to be had. I am endeavouring to procure most of them from abroad: the coffee-tree, if we could get it, might possibly take upon some of our berry-bearing tribe, such as the white-thorn, the quick-beam, and berry-bearing alder; and so, perhaps, would the *sassafras*. But I desire you to try the carob on the

common acacia and the ash, and the turpentine-tree on the plum, as I have directed the pistachia to be done, and every other plant that your own reflections may point out to you. I hope you will be so kind as to try what you can do this grafting season upon such as are fittest to be tried that way: those of thick and sappy barks, in the bark, others in the cleft, and by whip-grafting; and such as have thin and sappy barks, by budding, in the season for that; without forgetting your method of inarching, which seems to be the surest way you have. But I should be glad to see an accurate trial made of the antient method of inarching in the cleft; by which *Columella* (a writer of great reputation) assures us, that any tree whatsoever may be propagated on any other; and he appeals to experiments for the truth of it. Farewel.

Postscript. I shall here collect together all the experiments I have recommended to you above; and I hope you will lose no time in trying them. The turpentine tree is to be grafted on the pistachia, and on the plum. The pomegranate on the willow, the apple, the pear, and the quince. The later ripe apricot, peach, and nectarine, on early ripe plums. The tender late ripe *French* pears, on early ripe *English* pears. The carob on the willow, the ash, and the common acacia. The orange, lemon, citron, papaw, and other pomiferous exotic-trees, on the apple, pear, and quince. The mixis, azedarach, soap-tree, and other pruniferous exotics, on plums. The sassafras, the coffee, and other bacciferous exotics, on the berry-bearing alder, the quick-beam, and the white-thorn, and also on the service; since this will do on the white-thorn. The cassia fistulosa, the tamarind, and other filiquiferous exotics, on the common acacia.

I forgot to mention a method the antients had of grafting by terebration, or borings, which they used in the vine, and some others. They grafted the walnut between the bark and wood, which, I suppose, is

your rind-grafting; but they say it often went off; and they rather, I think, recommend grafting it in what they call the flesh of the root; and they also grafted some other trees in the root.

I omitted to inforce the experiment of the orange and lemon on the apple, by the example of the antients, who assure us, the lemon and the citron took with them on the apple; and so did the pomegranate on the apple, and on the quince and the pear; and the quince on it. The *Roman* husbandmen grafted the fig on the mulberry, as well as the *Greeks*; and so they did the mulberry on the fig: they also propagated the mixis on the plum, the white-thorn and the service: they grafted their apples too on the quince, which improved them. And they tell us, that any tree would take with them on the quince; though some affirm, that the quince would do upon nothing; which properties they observed in no other tree.

I have selected these out of a great many more graftings that are recorded by the antients, as being fittest for my present purpose; though perhaps the rest of them may be worth our consideration; and I will go a little out of my way to inform you of one thing, because it may encourage you in some of your experiments of another kind. Several of the antient writers of gardening describe the fruit produced by the apple grafted on the quince, (which they called melimela, or honey apples) as a very different kind from those grafted on the apple: and they give us other instances of the fruit being altered by the stock.

I cannot help adding this maxim of theirs, which, they say, was generally held for true, that any tree was to be grafted upon any other tree which was like it in the bark; but if there was a likeness in the fruit too, there could be no manner of doubt of the success.

Letter from the author to Mr. Fairchild concerning the foregoing one.

S I R,

The memoranda you sent me, have given me an extraordinary satisfaction, as it is plain they were penned by a person of learning; and I am very glad to find such as are men of letters, begin to turn their minds to the study of vegetables, and their improvement. By making such experiments, as are offered in the paper you sent me, we shall discover whether the antient or modern authors are most to be relied on; for my own part, I am sensible, that many things related by the antient authors are truths, but they are not without the contrary in some of their works, which, perhaps, might happen from their too great faith in *bearsays*.

I am not of the opinion of some men, who will not allow the modern practice to be superior to that of the antients, no more than I can side with those, who will not allow that a scholar may become more learned than his master, or a son be a better man than his father.

The arts of husbandry and gardening have improved very much in the few years I have lived in the world; and when I compare the modern practice with that of the antients, there seems to be a very wide difference between us and them; though we must at the same time acknowledge, that from part of the antient practice we have taken some considerable hints: but then on the other hand, the antients had many things among them, which experience has proved to be unnatural, and many others which are not yet either set aside, or confirmed. Now at this rate, where men have reason to doubt any thing advanced by an author, or take every thing for granted, the case is hazardous. Therefore let us still preserve our way of practice

practice to speak from experience; your experiments upon the letter you now sent me, will help to explain the matter, and open us a new door to knowledge.

You have told me that the mistletoe is of two sorts, *viz.* one male, which never bears any fruit, and the other female, which will bear berries at three or four years old; and, I think, you say, that the blossoms of both are very different; this plant is of a very singular nature, and deserves to be enquired into. I wish you would try the budding or grafting of one sort upon the other, and prepare to sow some of it at the proper season upon plants in pots, that we may try it by inarching.

I observe, that it will grow by seed almost upon any sort of tree, though the juices of such trees as it is propagated upon are of different natures, but it will not grow in earth by any means; now the growth of this plant upon every tree that we stick the seed upon, is rather grafting or budding, than sowing; if we observe the manner of its first laying hold of the tree, it becomes incorporated with the spongy parts in the bark of the tree, as an eye or bud does by inoculation (a).

As

(a) Inoculation is an operation in the propagation of trees, usually practised on all stone-fruit, and commonly known by the name of budding. Peaches, nectarines, cherries, plums, &c. as also oranges and jessamines, succeed very well this way, and it is indeed preferable to any other for fruit trees in general.

The method of performing it is this: the operator must be provided with a sharp penknife having a flat haft, the use of which is to raise the bark of the stock to admit the bud, and some sound bass-mat, which should be soaked in water to increase its strength, and make it more pliable. Then having taken off cuttings from the trees to be propagated, a smooth part of the stock must be chosen, which if intended for dwarfs, must be about five or six inches above the ground, but if for standards,

21 As far as I can yet think of the matter, besides in-
arching one sort of mistletoe upon the other, we might
possibly make it take by inarching either sort upon
any kind of tree whatever.

standards, it should be as many feet high. A horizontal cut
is then to be made cross the rind of the stock, and from the
middle of that another slit must be made straight downward of
two inches in length, that the whole may have the figure of
the letter T, but these must not be cut too deep. Then
cutting off the leaf from the bud, but leaving its foot-stalk
remaining, a cross-cut is to be made on it about half an inch
below the eye, and the bud is to be slit off with part of the
bark to it, in form of an escutcheon. The wood then must
be taken out of the slip of the bud, without pulling the eye
of the bud out with it, for if this happens, the bud must be
thrown away as incapable of succeeding. When the bud is
thus prepared, the bark of the stock is to be gently raised
with the flat haft of the penknife, and the escutcheon of the
bud must be slipped in, and placed very evenly between the
bark and the wood, cutting off any part of the rind of the
bud which may be too long for the slit made in the stock.
The whole is then to be gently tied up, beginning at the
lower part of the slit, and taking great care not to injure the
eye of the bud, which is to be left out at the slit. In three
weeks or a month the bud will shew that it is joined, and
then the tying round the stock must be loosened; and in the
March following, the stock must be cut off about three inches
above the bud, sloping it that the wet may run off. To this
part of the stock the shoot proceeding from the bud is to be
tied, lest the winds should loosen or displace it; and when
the tree has stood one year in this state, the stock must be
cut down close to the bud.

The season for inoculating is from the middle of *June* to
the middle of *August*, according to the forwardness of the
trees. When the buds are formed at the ends of the shoots
of the same year, it is a proof that the tree is fit for the pur-
pose; the first tree that comes in season to be inoculated is
the apricot, and the last the orange tree: and in doing this,
choice should always be made of a cloudy day, that the sun
may not dry up the buds too quick; and in some very tender
plants, a part of the wood in the escutcheon of the bud should
be left in. *Miller.*

I would desire you to inarch the double or single stock gilly-flower upon the wall-flower, for they seem so near a kin, that I think it reasonable enough to try the experiment among the rest.

If it should succeed, you may perhaps preserve the stock gilly-flowers longer than they usually last of themselves; and it may happen that you procure such seed thereby, as may produce some new variety.

The single and double blossom dwarf almonds were growing upon the muske-plum; and since that will do, I am persuaded the sweet and bitter almonds will take upon the dwarf almonds; then I suppose we may have bearing almond-trees in very little room.

I have considered that before I cannot help observing to you, Mr. *Whitnill's* contrivance for such as have small gardens, that upon a few trees, they may have most of the best sorts of fruit: indeed the trees will not last so long by such practice; but it is making the most of a little, and is a great improvement for a small spot of ground: he has a peach-tree, whereon are now growing the apricot, the nectarine, and the cherry; and the plum too might as well be there as the rest, as the peach itself is grafted upon the plum; the almond likewise would do as well as any of the others; then we might have on one tree six different sorts of fruit, some of which are pretty remote from the rest.

The peach is rough coated, a rough stone, and its foot-stalks so short, that it can hardly be called so.

The cherry, contrary to the peach, brings its fruit in bunches or clusters, hath a smooth coat and stone; its stalks are very long, and the fruit transparent.

The apricot has a rough coat and smooth stone, and its leaves and manner of shooting are very different from the peach; and nothing that I can observe in it has the least resemblance to a cherry, but the smoothness of the stone. Then the plum has a longer stalk than either the peach or apricot; some sorts of plums have

foot-stalks

foot-stalks almost as long as those of the cherry; the coat or skin of the plum is smooth, but less transparent than that of the cherry, by means of the dust it is covered with, which we call the blus of the plum; and then the leaves and shoots are different from either the cherry, peach or apricot.

The nectarine indeed has a near resemblance to the peach in every thing but the skin or coat of the fruit, which in the nectarine is always smooth, like that of the plum; but then when we compare it with the plum, the leaves and shoots are very different one from another; the stones of the nectarines are rough, and those of the plum always smooth. The almond most resembles the peach; its coat and stone are rough, and there seems very little more difference between them, than that the fleshy part which covers the stone of the almond is not for eating, as that of the peach always is; so that I have thought sometimes when I have eaten a peach, whose flesh was dry and hard, that the kernel of the fruit might be as good as an almond, or that it was of the almond race.

Upon mentioning this to a friend, he desires you will try the peach, the plum, the cherry, the nectarine, and the apricot upon the dwarf-almond, to make them bear in a narrow compass; for the dwarf-almond will take upon a plum, and he concludes the plum will do upon the dwarf-almond; if so, the others may as well be grafted upon it as the plum.

Thus far for stone-fruit one upon another, though there are wide differences seemingly between the one and the other; some of them almost as wide as between the walnut and the peach: yet one may try this for experience sake, although the walnut be a tree which bears earliest or last, and the peach does not; but yet the peach, according to your observation, has two sorts of blossoms upon one tree, viz. what are commonly called false blossoms, and fruit-blossoms; or in our terms, male and female blossoms.

I remember once you observed to me, that the goosberry would take upon the curran, and the curran upon the goosberry; which is uniting families, that are seemingly more remote than any we have mentioned, the one being a bunched fruit, and the other a single berry; but I remember you well observed at that time, that you thought it was not the bare appearance of the fruit which confirmed their relation to one another, but the likeness of the seeds or kernels which were inclosed in such fruits; that it was the seed or kernel which produced trees of the same order, and that the pulp or outside flesh, which encompassed such seeds, was only provided by nature as coverings for them, or to give them their just nourishment, and full degree of perfection for germination or sprouting, when they were put into the ground; this seems so reasonable, that it is worth our while to consider further of it, notwithstanding there are some who hate new discoveries, when they are not their own, and deny every thing which they cannot comprehend: by the by, the plum, peach, nectarine, almond, apricot and cherry, have all kernels so much after the same manner, that your reasoning seems to determine why they agree so well together; and so has the goosberry and curran (b).

I am Yours, &c.

R. BRADLEY.

C H A P.

(b) The principal kinds of grafting, are, 1. Grafting in the rind, called also shoulder-grafting, and by some crown-grafting; this is only fit for large trees, and the grafts in this are set in form of a circle or crown. This is most properly performed in the latter end of *March* or beginning of *April*. 2. Cleft-grafting, which is also called by some stock and slit-grafting. This is proper for stocks or trees of a lesser size, and not exceeding two inches in diameter. This grafting is to be performed in the months of *February* and *March*, and supplies the failure of the eleuteicon-way, which is usually performed

CHAP. VII. *Observations and experiments relating to planting of trees in clayey, chalky, and gravelly soils; with several improvements for planting of wall-trees.*

THERE is nothing which has given a greater check to the progress of gardening, than the unartful proceedings of unexperienced men, or of those who will not give themselves time to consider deliberately

performed in *June, July, and August.* 3. Whip-grafting, which is also called tongue-grafting; this is proper for small stocks of an inch, or an inch and half diameter; and from this down to the smallest size; this is found the most effectual way of any, and is what is now almost universally practised. 4. Grafting by approach or abscission. This is performed when the stock to be grafted on, and the tree from which the bud is taken, are so near together that they may be joined. This is best performed in the month of *April*, and is called by some inarching; and is chiefly used for jessamines, oranges, and the tenderer exotic trees.

All those trees which are of the same tribe, that is, which agree in their flower and fruit, will take upon one another; thus all the nuts may be engrafted on one another; as may also all the plums, and all that are allied to them; as the almond, peach, nectarine, and the like: but as these generally lose a great deal of gum in the grafting, the operation of inoculation is greatly more proper for them. All the trees which bear cones will succeed very well on one another, even though some shed their leaves in winter, and others do not. Thus the cedar of *Lebanon* and the larch tree do very well on one another; but these, because they abound so greatly in resin, must be grafted by approach, because the resin of the graft being lost from it before it is set into the stock, makes it otherwise often miscarry. Bad weather will often destroy the hopes of the best operator; otherwise with these regulations the whole generally succeeds very well; and is not only of use for propagating many exotic plants, but even will make
very

deliberately what they are about; it is not the bare knowledge that a tree has a root, and that the root must be set in the earth, that will give success to the planter's

very tender ones bear our climate, by placing them on the hardier stocks of the same kind.

The ancients were very fond of grafting, and if we are to understand their writings as they now stand, we must acknowledge that they had an art greatly superior to ours, as they could make the most unlike trees succeed upon one another. Thus they grafted the mulberry on the fig, the plum upon the chesnut, and so on; but it should seem that either the authors who have affirmed these things wrote upon hearsay, without any knowledge of experiments, or else that they called other plants by these names; since experience abundantly shews us, that no tree, however like another in leaf, or any other particular, will be ever made to succeed upon another, unless they have both the same fructification. *Miller.*

Many have talked of changing of species, or producing mixed fruits by engrafting one tree on another of the same class; but as the graft carries the juices from the stock to the pulp of the fruit, there is little hope of succeeding in such an expectation by ever so many repeated grafts; but if after changing the graft and stock several successive times, you set the seed of the fruit produced on the graft in a good mould, it is possible that a change may happen, and a new mixed plant may be produced. Thus the almond and peach may, by many changes in the graftings, and by intertrations of the stones of the peaches, and of the shells of the almonds, and by terebrations of the stem of the root here and there, alter their nature so much, that the coat or pulp of the almond may approach to the nature of the peach, and the peach may have its kernel enlarged into a kind of almond; and on the same principle the curious gardener may produce many things of such mixed kinds. *Philos. Transf. N° 46.*

Mr *Du Hamel* of the Academy of Sciences of *Paris* has observed, that in grafting of trees there always is found at the insertion of the graft a change in the directions of the fibres, and a sort of twisting or turning about of the vessels, which greatly imitates that in the formation of certain of the glands in animal bodies; and he very judiciously infers from thence, that a sort of new viscus being formed by this means, the fruit

planter's undertakings; he must know how to judge of the soil and situation each particular tree requires, and learn how to assist either of them without extraordinary expence. When therefore we meet with artists of this sort, who have reason for their guide, we ought to regard them as public benefits.

In the disposing of clay-grounds, chalky or gravelly soils for gardens, it is not uncommon to see such wrong steps taken in the ordering the works upon them, as tend to the destruction of the greatest part of the plants to be set in them, which seems to happen chiefly from the want of due consideration in either the undertakers or planters.

Where the surface or the upper soil is not above three or four inches thick, and the next stratum or layer of earth is stiff clay, it is a practice too frequent to dig trenches for the beds about fourteen or eighteen inches deep, to remove the clay and earth dug out of them, and to fill them again with fine fresh earth brought from some other place. The arguments which I have heard for this method are chiefly these;

viz.

fruit may very naturally be so far influenced by it, as to be meliorated on the new branch; but that no such sudden and essential changes can be effected by this means, as too many of the writers in agriculture pretend. This author observes, however, that this anatomical observation alone would not have convinced him of the falsity of too many of these relations, had not experiments joined to confirm it; he tried many grafts on different trees, and, for fear of error, repeated every experiment of consequence several times, but all served only to convince him of the truth of what he at first suspected. He grafted in the common way the peach upon the almond, the plum upon the apricot, the pear upon the apple, the quince, and the white-thorn, one species of plum on other very different species, and upon the peach the apricot and the almond; all these succeeded alike, the species of the fruit was never altered, and in those which would not come to fruit, the leaves, the wood, and the flowers, all were the same with those of the tree from which the graft was taken.

viz. that the surface or first layer of earth was not deep enough of itself to nourish the trees that might be planted in it; that the stiff clay below it would be very pernicious to trees of most kinds that were to strike their roots into it; and to avoid both these evils, the trenches were cut, and fine mould thrown into them. The objection to this practice is, that when the wet begins to fall, these trenches in the clay receive the water, and are like so many basons to hold it, and so renders the fine earth that was put into the trenches perfect mud; for a body of clay or chalk will not admit water to pass through it; and therefore it is almost a miracle to see any plants live or thrive in such trenched beds or borders, unless they are such as naturally live and grow in water or in bogs. I have observed many thousands of plants destroyed by planting them in such trenches of clay and chalk; although there were drains made from them as artfully as possible, yet the wet always corrupted and chilled the earth in them.

Mr. Fairchild well observes, that where the first layer of earth or soil is so thin as in the case I mention, and the next layer or stratum is either gravel, chalk or clay, we should never dig into these bad bottoms, but raise our good earth to a due thickness upon them where we design to plant our trees; or else raise hills of good earth to plant them on; for a tree so planted, will turn its roots when they come near either the gravel, chalk or clay, and spread them in the surface, though it is not thicker than two or three inches. And it is observable, that when holes are dug in these stubborn soils, and filled with good earth, the trees planted in them, when they spread their roots to the borders of such holes, so as to touch the gravel, clay, &c. will begin to canker, and presently decay.

I have also taken notice, that the surest way to manage such grounds as I have been speaking of, is

to pare off all the surface; and after it has had due time to mellow, then to lay it in beds upon the clay, gravel, or chalk, without cutting or trenching so much as an inch deep into any of them; by which practice I find plants thrive and grow well, and are out of danger of decaying before their natural time (a). This is one way to secure our trees from harm, and of giving them liberty to seek and find out the nourishment proper for them; but if we encompass their roots with earths opposite to their taste, they will starve themselves into distempers.

As we are come thus far, I shall next consider how a fruit-tree may be planted for a wall, to receive more advantages than it will do by the common way of planting; and for this thought I am obliged to the curious Mr *Whitmill*, whom I have so often mentioned. He observes very justly, that the common practice of planting trees against walls very often occasions the trees to decay in few years; *i. e.* by planting them so near to the wall, that every part of the root has not a convenient space to spread itself, the part next the wall must want nourishment in many cases, although the vine has an advantage from the mortar in the wall, and the peach loves to shoot downright in the earth; but yet, as I have observed before, the root of the peach will want moisture in summer, and cannot always find a proper earth below to nourish it.

The method indeed which Mr *Whitmill* prescribes, is chiefly designed for such pears as want the assistance

(a) The pores of clay and chalk are more closely compacted together, and do not so easily give out their salts that are contained in them; nor can the fibres of every tender plant make their way through them in quest of their proper nutriment. But if the parts of the clay be opened by digging and breaking it into small particles, and those parts be kept open by a mixture of some sharp sand, or some other body of the like quality, the effects of its vigour will plainly appear. *Miller.*





of a wall to ripen their fruit; but it is my opinion, that every sort of fruit-tree, which is a vigorous shooter, will agree as well with the method he directs as the pear-tree. First of all, he advises to prepare a bed about four feet wide, under the influence of a well exposed wall, and to plant our trees about the middle of it, so that the roots may enjoy the liberty of two feet earth on the wall-side, before they can reach it, which will give them strength of shoot equally in every part, and preserve them in health better than the common way of planting. But to curb this luxuriance, and bring the trees to bearing, the shoots are to be spread flat or horizontally, so as to make a covering for the bed, which perhaps may be near two feet above the earth. A few stakes and common arbour-poles will direct these shoots, as we may observe in *Plate XI. Fig. I.*

As the trees planted and trained in this way spread themselves, Mr *Whitmill* would direct all the shoots which are within reach of the wall to be nailed up to it, which bending will check the overflux of the sap enough to bring the shoots to a bearing state, if the first spreading of them upon the poles does not do it. By this practice a wall of eight feet high will be sufficient for a tree that would otherwise require one of twelve or sixteen feet, and have many other advantages; as first, the part of the tree which spreads over the bed, is secured from the frost in the time of its blossom, only by covering it with a mat; and that brings fruit, when the part nailed to the wall receives damage either by frost or blight. Secondly, the reflection of the wall will contribute to the ripening of the fruit upon the flat part of the tree. Thirdly, the fruit will be well nourished, because the roots have the due liberty of the earth, and are not too much exposed to the sun in hot dry seasons: and there is a better opportunity of letting the over-abundant sap spend itself, than can be had in trees planted against walls in the

common way. The letter A in *Fig. I.* points out one of the vigorous shoots, which is left as a waste pipe, if there should be occasion, so named and practised by Messieurs *Warners*. This waste pipe, as I shall also call it, serves to rectify the sap in the other parts of the tree, and bring it into a bearing condition.

Ibid. Fig. II. at B, B, B, B, we may observe the method of training a fruit-tree against a wall, according to the method prescribed by Mr *Whitmill*; and if by this means it is yet too luxuriant, he advises the binding some of the most vigorous shoots with strong wire, which he supposes will check the sap; and in some cases he even advises the binding close with wire some of the larger roots. But to curb the over-growth of fruit-trees, Messieurs *Warners* cut what they call a wild worm about the body of the trees; or score the bark quite to the wood in the manner of a screw, which must be done with a sharp knife. Another practice of these gentlemen, which is no less philosophical, is the grafting or budding here and there a cion of good bearing trees into those which are too wanton in their growth; which experiment fully answers the design, and brings those trees which are grafted upon to bear well. But I conceive this would yet be more successful, if we were to inoculate or graft the strong shooters, or less bearing sorts of trees upon the great bearers; because those trees which are apt for bearing, will feed the cions of the vigorous shooters only with such sap as is well digested or ripened, and will alter their luxuriant quality at once; whereas the former method of grafting the good bearing kinds upon the bad bearers, requires more time to render the tree fruitful; for the luxuriant quality of a whole tree working in full power upon a few buds or cions of the good bearers, they can do little more than resist the fluent sap for a season or two; after which they require time to insinuate their prolific virtue into the whole tree they are grafted upon. Since
the

the subject is now before me, I shall mention an observation or two which I have made at Mr *Whitmill's*, that in some degree may be useful to our present purpose, and confirm some experiments of the late excellent Mr *Evelin*.

Mr *Evelin* mentions in some of his works, a method of grafting orange-trees; but that method has had so little weight with the gardeners, that I have never seen it practised, till by accident I found it done by Mr *Whitmill*, and even, then as he told me, it was partly the effect of chance which put him upon it; for while his young orange-stocks were in his conservatory, the mice barked a couple of them so near the root, that there was neither a possibility of inoculating or inarching them, which gave him an opportunity to try the experiment of grafting them in two different ways, the one in the bark, the other in the cleft; the success was, that both the grafts took, and it was observable, that the orange tree grafted in the bark, shot very vigorously the same summer; while the other, which was grafted in the cleft, shot with more moderation, and put out several blossoms a few months after grafting, which, I suppose, might happen from the pinching of the cleft, and thereby checking the too vigorous progress of the sap of the stock; both these, however, made very handsome plants in three or four months after grafting.

When he inarches orange-trees, he so far joins in opinion with the gentlemen beforementioned, that to make them bear soon, he always chooses a flowering branch to inlay into his stocks, and from these he has fruit immediately; but on the contrary, he inarches vigorous shoots in those stocks which he designs to grow large.

At the same time he shewed me some myrtles which were inarched one upon another, and had taken very well; among these we found the large leaved kinds upon the small leaved kinds; the nutmeg-myrtle upon

the upright myrtle; the striped upon the plain, and the double blossom upon several sorts; which made me recollect some thoughts I once had, of making a pyramid of myrtle, whose base should be garnished with the *Spanish* broad-leaved myrtle, to be followed with the nutmeg; next to that the silver-edged myrtle, and upon that the upright sort, to be succeeded by the rosemary and thyme-leaved kinds to the point, upon which we might have a ball of the double-blossomed myrtle, that would make a fine appearance.

While I have an opportunity of the copper-plate, designed to explain Mr *Whitmill's* method of managing some kinds of fruit-trees against walls, I shall take occasion to mention the *French* method of treating wall-vines, which though it has little trouble in it, will give us extraordinary fruit.

In order to this, we must first bring our vines to shoot with vigour, that we may have two or three shoots of strength to lay to the wall for service; and this depends upon the pruning of the small shoots: for example, we will suppose we have a young vine planted in the spring, which at *Michaelmas* the same year, has shot two or three small twigs about the thickness of wheat-straws; when these twigs have done their growth, we must cut them down, so as to leave only one bud upon each shoot; then the spring following, the sap, which by nature was designed to furnish all the buds in the twigs we cut off, will be employed only to nourish the few single buds which we left in pruning, and will sling those remaining buds into vigorous shoots; which, in the vine, are those that bring bearing branches. These shoots proceeding from the buds in the spring, will, at *Michaelmas* the same year, be at their full growth; and should not be broken or touched with a knife while they are in growth, for that will set them to branch, which should be avoided.

Being

Being come so far as *Michaelmas*, we are next to inquire what length we may prune the shoots of that year to, when we lay them down to the wall; and that pruning we must order according to the strength of the shoots: if they are about nine parts in twelve of an inch diameter, they may be left about a yard and a half long; or if about half an inch diameter, they may be left a yard; or as they are less, must be shortened in proportion. It is a maxim that where we find the joints short in shoots of vines that are of good substance, we may leave them all upon such shoots.

Ibid. Fig. III. shews us a vine pruned at *Michaelmas*, the second year of its growth, which had three vigorous shoots. C is one of them laid down horizontally to run parallel with the border. D is the second shoot above it, pruned and laid to the wall in the same manner. And we are to observe that the shoots C and D are to produce bearing branches the third year. E is the third shoot pruned to two or three buds, which are left to furnish shoots for laying to the wall at *Michaelmas* the same year, when the shoots C, D, are to be quite taken from the vine, unless a bud or two, to supply the following year some shoots for laying down.

Fig. IV. gives us the appearance of the same plant in *Fig. III.* at its full growth; and the manner in which the shoots, or bearing branches proceeding from those laid down the second year, ought to be nailed to the wall the third year.

F in *Fig. IV.* is the same shoot as C in *Fig. III.* and G *Fig. IV.* is the same as D in *Fig. III.* The letters H, H, H, H, shew the shoots proceeding from them in the third year, and the shoots marked I, I, point those strong shoots, which should be preserved to succeed the shoots F, G, when the grapes are ripe; for then, as I have observed before, F, G, must be taken away.

CHAP. IX. *An account of a new method of transplanting trees of any bigness with safety, either while they are in blossom, or with fruit upon them; so that gentlemen who come late to their estates, may, in a few days, furnish the walls of their gardens with trees full of fruit; or plant wildernesses or avenues that shall afford them an immediate shade, and grow with as much vigour as if they had not been transplanted. &c.*

IT has been a general complaint, that plantations of all sorts are so tedious in their growth, that under five or six years one can hardly expect our garden-walls, or other garden-plantations, to yield us a quantity of fruit sufficient to answer our expectations, or reward our labours: or would we desire shade, we must wait still much longer for it; and yet there has been no remedy proposed for either of these inconveniencies.

The first thoughts that occurred to me in order to remedy this deficiency related only to fruit-trees; for which end I contrived the raising of fruits of all kinds, in cases or boxes, that might take to pieces at pleasure, so that these trees might be removed with all the earth about them, from one place to another, with safety: and also that such trees, while they were growing in the nursery in their cases, should be trained in espalier, so that at their removal they should fit a wall at once without difficulty. This I have fully explained in some of my former works, and is now in practice; but then this does not extend further than the propagating of wall-trees.

The next piece of knowledge that I gained towards the point in hand, was from Mr Secretary *Johnstoun* at *Twittenbam*, where I saw the advantage of transplanting trees of all sorts in summer: it was a discovery of that

that gentleman's, and practised by his directions with wonderful success, insomuch that some lime-hedges about ten feet high were removed in *May*, *June* and *July*, and they gave very little indication of a removal; large pear-trees and apple-trees were removed, and grew in great prosperity; and especially some *Scotch* fir-trees were transplanted out of a nursery, the same summer, and had shot above a foot before the others remaining in the nursery began to stir or move in their shoot. There was one thing remarkable in these transplantings, that the fir-trees had their heads remaining upon them, which contributed to their better growth; and it is the common opinion that trees of this kind cannot be transplanted when they are of any tolerable bigness; and yet these were near thirty feet high.

The elm-hedges were forced to be cut or pruned when they were transplanted, to put them into form; and the orchard-trees were lopped, for the better convenience of carriage; however they brought good fruit the next year; and, I suppose, would bring much more, if all their branches, or the most part of them, had remained upon them.

The method of transplanting these trees, was by preparing holes for them before they began to be taken up, and the earth taken out of these holes was made very fine, and mixed with water in large tubs, to the consistence of thin batter, with which each hole was filled, for the tree to be planted in, before the earthy parts had time to settle or fall to the bottom. A tree thus planted in *pap*, has its roots immediately inclosed, and guarded from the air, and as the season then disposes every part of the tree for growth and shooting, we shall find that it loses very little of its vigour, if we have been careful of its roots, to wound few of them at the taking it out of the ground, and have not let them grow dry in the passage from one plate to another.

The

The great success which attended this manner of planting, soon gained credit enough to invite many to follow the example; but as it had been an old custom to plant in winter rather than in summer, it was thought necessary by some people to join that old custom to the new invention of the pap, and so all was frustrated; it would have been necessary to have thought the tree was not in the same growing state in winter that it is in summer, and that when neither the draught of the tree, nor the temper of the air, can draw away the extraordinary wet from the root, which is contained in the pap, then that the pap about the root serves only to chill and rot it; when on the other hand, in the summer, all trees are filled with fluent sap, and their chief refreshment is water, which neither their own powerful spirit of growth, nor the warmth of the air, will suffer to remain too long about them. It is a season when all plants of the smaller kinds, which are carefully removed, will strike root in a day or two, and I see no reason why large trees will not do the same in a few days at that time of the year; but in the winter-months the roots will not renew themselves; therefore it is not necessary to transplant trees in that dead season, if it can be avoided, especially in places abounding with water; or to fill their holes at that time with pap, which, for want of warmth and vigorous life in the trees, must stagnate, and corrupt, and injure the root.

At the time of transplanting a tree, it is by no means proper to cut off any of the branches, or wound any of the vessels, if possible, that the sap may circulate more freely, and the tree remain in better spirit, till it has renewed its roots, which of necessity must be wounded at transplanting.

Now, as the cutting and wounding of some roots of a tree, and even among them some of the capital ones, cannot be avoided, I thought it convenient to contrive

contrive a mixture of gums, to plaister over the wounded parts of the great roots, and prevent the air and wet penetrating too much into the vessels of the roots; and at the same time, if the root was very large, to mark its corresponding limb or branch in the head, to be cut off when we see it begin to grow, and to be then plaistered in the same manner as the root was done before. I find this plaistering of the wounded parts of a tree to be of great use for bringing large and vigorous shoots, and preserving the tree from canker or the rot, which will attack it by little and little, if the mixture of gums is not applied as soon as any limb or branch is cut off.

Nor must we have less care to be quick in the removal of our tree from one place to another, for if the roots grow the least dry, we may presently discern a failure in the top branches which correspond with them, and that will require time to remedy; the more they fail, the longer time they require for their recovery. For this reason it has been thought impossible to remove a large tree to a considerable distance with any success, though now I am satisfied of the contrary, having by accident met with a preparation, with which, if we anoint the roots of a very large tree, we may let it lie out of the ground one day in the hottest summer, and it will not drop or flag a leaf; common soap will do for two or three sorts of trees; but I find it is not agreeable to all, being subject to canker the roots of many.

In this way of planting there is one convenience which is not in the common way, and that is, that here we are not to take any earth about the roots, which will make their transportation more easy. The small ones, such as currans, gooseberries, and such like, together with all the flowering shrubs, when their principal roots, that happen to be cut, are dressed with the mixture of gums, which must be done while the tree is taking up; these I say must have their

their roots immediately plunged into a vessel of water, and fine earth mixt like mud, in order to convey them fresh to the place where they are to be planted, and then filling the hole with water and fine earth well stirred together, plant your trees in that gap, and continue adding more earth and water, till the holes are filled. We must then fix our plants very well with stakes, especially if they are tall or large trees; and as the gap begins to harden, it must be carefully watched, to prevent cracking, which it will surely do, if the top of it is not stirred or broken a little with a spade; a little fresh water and earth should be poured over the whole, which should then be covered with fern, or such like; but green turf is much the best.

I have for several years past made the experiment upon gooseberries and currants in the manner I mention; In the months of *May, June, July* and *August*, and they never failed to ripen, and carry their fruit very well the same year, and grow vigorously. Again, one good which attends this way of planting is, that the plantations do not require any watering after they are once settled, for they presently renew their roots, which those trees planted, about the winter months, will do but indifferently the first year, and sometimes not at all.

To remove small plants from place to place, we may put their roots in bladders of water, or of earth and water, and carry them two or three days journey with safety; but if the journey be long, I rather chuse earth and water finely mixed, than simple water; and a bladder may be tied close to the stem of the plants, without being in danger of breaking, as a vial would do.

By this method, and the assistance of the prepared gums, and a viscous preparation, I have removed peach-trees, nectarines, pear-trees, plum-trees, and cherry-trees, with fruit upon them, both green and ripe,

ripe, some of which trees had been trained against walls upwards of six years; and though some of them were carried above fifteen miles, they grew perfectly well, and preserved their fruit; so that by this means any gentleman that had a mind to furnish the walls of his garden, might chuse his fruit-trees with the fruit upon them, and have them removed to his own garden at a minute's warning; and besides the satisfaction of knowing that every tree brought fruit to his liking, he would have the pleasure to have gained six or seven years of time in one day.

By this method of transplanting trees, there is yet one advantage more, which is, that if a gentleman has planted a fine collection of fruit-trees in his gardens, and that some accident happens whereby he is obliged to quit his garden on a sudden, his fruit-trees may be removed with safety from *May* to *August*, and he will lose no time.

This year, in *April*, I removed an old standard plum-tree, near forty years old, at *Molesey*, when it was full in blossom, and though the three principal roots were cut off each as thick as a man's wrist, and a proportionable number of boughs which corresponded with them, it is now growing, and has a good deal of fruit upon it; but the method of moving a tree in this state to a little distance, is very different from moving a tree with fruit upon it.

In the doing of this work, a gardener must first be very cautious in applying the mixture of gums, and that he does not use that kind of mixture which is made for kernel or pepin-fruit, to a stone fruit-tree, or the contrary.

Secondly, He must take care to plaister the wounded parts of the great roots as soon as each of them is clear of the earth; and if the trees are to be carried to any great distance, to anoint their roots as soon as possible with the viscous preparation, for in hot weather they will dry in a minute.

Thirdly,

Thirdly, If the soil they are to be planted in be clay, we are not to make the holes for the trees in the clay; for though we make them twenty feet wide, and were to fill them with the best sifted earth and water, the tree will decline in the winter, though it will not fail when we plant it in the summer. In the letter concerning Mr Potter's ranunculus, we may see the reason (a).

With the like success have I transplanted two or three elms about thirty feet high, so that there has been no appearance of their removal; their leaves have remained green and bright, and are now prosperous; their heads are full, and they afford as much shade since their removal as they did before; and by the same rule I am satisfied, that there is not a tree in *England* which is sound, and is not of more weight than can be carried from one place to another, but might be transplanted with the same safety as one might plant a cabbage; but there must be due time allowed to do it in, and the planter must be very careful in using his mixtures and preparations, and the labourers as careful in opening the roots; so that in a few days time, if there was a sufficient allowance of men and money, a house might be encompassed with a full grown wood, and a garden compleatly planted with bearing trees of every sort of fruit.

Concerning a new method of bringing pear-trees to bear fruit; and of constructing a water-clock.

S I R,

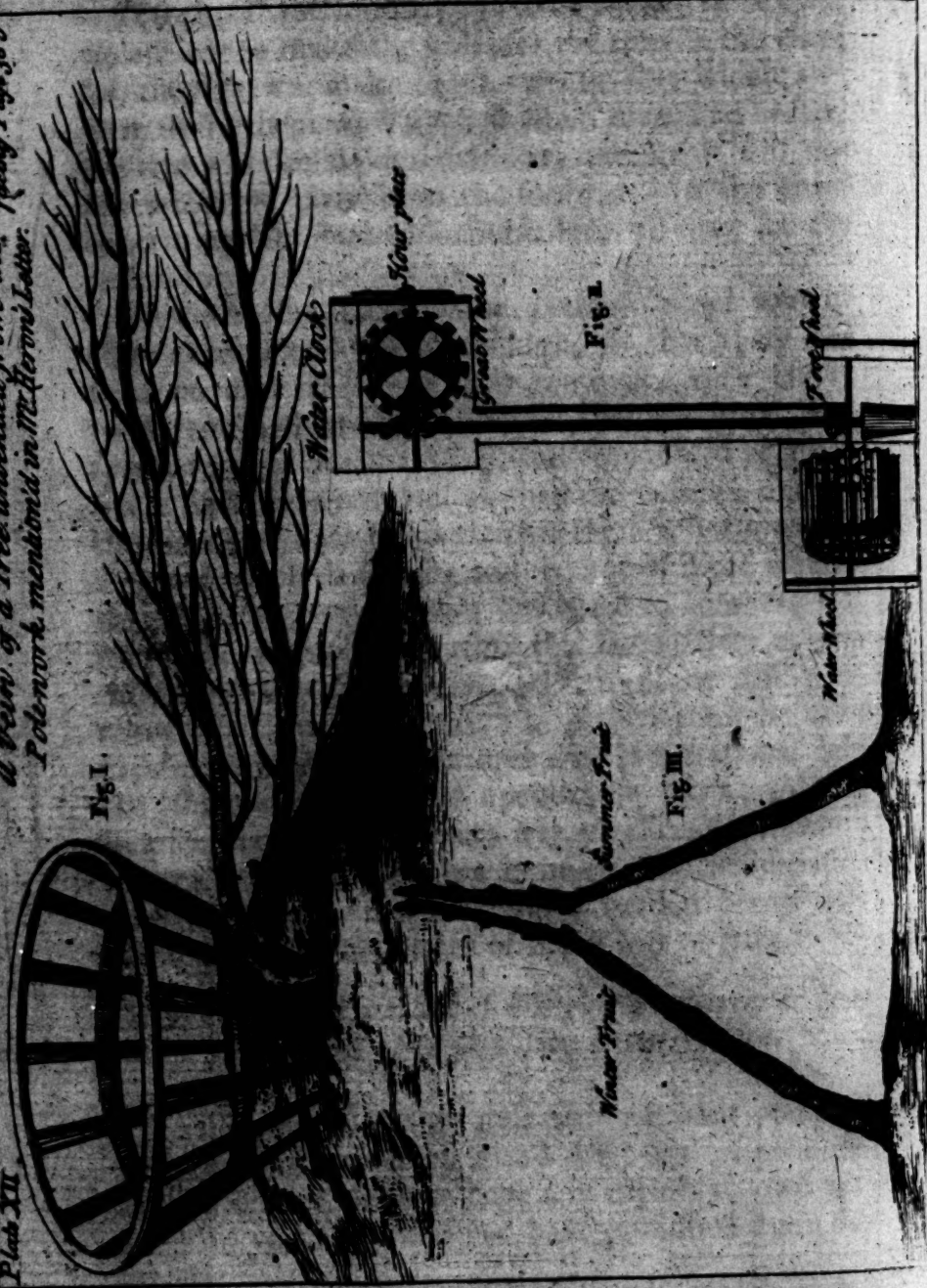
I have perused the greatest part of what you have written about gardening with a great deal of pleasure; and I must say, such as have any curiosity, owe very much to you, for what you have published upon that subject.

There is a piece of amusement that I have had at my house several years, which any gentleman, who has

(a) See Chapter 19. Part II.



A View of a Tree unbanded from the Spring Page 386
 Polework mentioned in the Heron's Letter.



has the convenience of water near his gates, or running through his gardens, may put up for his pleasure and use. It is a clock that goes by water, being a perpetual motion, in regard it needs no winding up: I have known it go a month together without losing time, the water when once truly regulated being very exact. I have sent you here inclosed the model of it.

I must acquaint you likewise of a small piece of improvement, which I do not find hath been put in practice by any but myself, which regards dwarf-trees trained circular ways, after the manner of a screw, whereby I make a tree forty feet, not to rise five feet high: the tree is carried round upon a frame of small poles, made into a bell-figure, *Plate XII. Fig. I.* and as it advances in growth, is tied gently to the frame by pieces of woollen yarn, raising it a little as it winds about, and therefore it needs no pruning. This way of training dwarfs consumes the sap, and makes the trees very fertile; and when the frame decays, the tree keeps its station, and looks very well. If any shoots offer to spring up in the summer from any of the side branches, they must be pinched from their first beginning, and when a frosty night threatens them in the spring, make a plain frame upon a large hoop, covered over with a piece of canvas, or pitch-cloth, to cover the whole, which preserves the flourishing buds and their knitting till the danger be over, and keeps them also from cold rains and winds in the spring.

I have likewise hastened the ripening of fruit by a fortnight, by taking off the earth from about the trees near to the roots, after the fruit is grown to a size of bigness as much as you expect it will come to; and in dry weather by giving them a little watering in the morning; this way has a good effect upon vines and early cherries, or plums, or the avant peach. I had fruit upon trees used after this manner, two weeks, or at least ten days, before others of their kind that

were not so prepared. Sir, I hope you will pardon my freedom in communicating what I thought was not yet in universal practice, being with all due respect,

Your very humble servant, A. HERON.

Postscript. The water-wheel of the clock, *Ibid.* Fig. II. is about eighteen inches diameter, and of the same form with the wheel of any ordinary corn-mill; its axle-tree on the side of the standard is near a foot long, with a screw on the end of it, that when it turns, takes in the teeth of the foot-wheel, which consists of twelve: the axle-tree hath a pinion beyond the screw, where it turns in a small piece of wood set up for the purpose: the standard is five feet high, with a gutter cut in two inches deep, and as much broad, in which turns the shank of the foot-wheel, to which it is fixed with a pinion below the wheel to move upon, in a little frame of iron, as the pinion itself is to keep it steady in its motion. There is a box fixed on the top of this great standard, ten inches diameter, with a hole cut out in the bottom, to let the shank or standard of the foot-wheel go up through it: this has a screw upon the top of it, with a pinion in a frame upon the top of the box. The screw turns a wheel of sixty notches within the box, and the axle-tree of this great wheel has a screw upon it, that turns another wheel of twenty-four notches, the end whereof goes through, and has a pointer fixed upon it without the hour-plate, like a common clock. Where the water is brought there is a square hole cut in a piece of board, with a shutter upon it, whereby you give more or less water, till you bring it to one exact time. The great standard must be cut through half way, where the foot-wheel is to stand, about four inches wide*.

This

* Fig. III. Plate XII. points out a method of grafting two trees which our author conjectures would by that means be

This letter of Mr *Heron*, contains so much good matter in it, that there is large room for reasoning. It is the opinion of our greatest gardeners, who have studied philosophically of the matter, that whatever contributes to check the sap, does at the same time bring fruit upon a tree, or bring a tree to bearing much better than by wounding or cutting it. Some sorts of pears are given to shoot with too much vigour, and run to a very great height before they come to bearing, and then their shoots require a greater length of time to be brought to blossom, than such trees as are less vigorous in their shoots: but both these should be carefully considered by the gardener, who is not to cut off every large shoot, because they will not bear at once, for some will not bring fruit till the third year, though others bear upon the two years, and others even upon one year's wood. The want of this knowledge has very likely been the reason why some of our best pruners have not always had so good success as one would wish. But to prevent mistakes which may sometimes happen in pruning, I see no surer way than to follow the method prescribed by Mr *Heron*, for by twining the shoots of the pear-trees about a frame of poles, the sap is so much curbed, that the tree may be brought to bearing sooner than if it was to run at length; besides, a tree so ordered,

C c 2

be made to produce fruit of very different qualities; for instance an apple, the one side whereof may be sweet and the other sour, the one side larger than the other, and, when boiled, the one side soft and the other hard. The method he proposes for this end is to chuse two trees of different sorts, and taking off the bark on the one side from each of them, so that their wood may come in contact with one another, to bind them gently together, by which means he thinks they may unite, and scatter their different qualities over the whole tree. If this sort of inarching should take, one of the trees should be cut from the other, so soon as the intention of inarching them is answered.

dered, will take up much less room than if it was to be managed in any of the common ways, and there is no danger of cutting off any of the bearing wood; still there is one advantage more attending this method, which is, that such trees may be defended without much expence from dangers while they are in blossom.

To Mr Richard Bradley, *concerning the management of fruit-trees.*

SIR,

I have here sent you, according to your desire, my thoughts concerning the management of fruit-trees; and I shall begin with the building of the walls. I cannot fall in with the advice which some people give for building them on arches, because of these following objections. First, If it be a party wall in the garden, and planted on both sides, the trees will run through and rob one another of their nourishment. Secondly, If it be an outside wall, there are commonly elms at some small distance planted to break the violence of the winds, whose roots will the easier run through and rob the fruit-trees of their nourishment; but if there be not, it is but seldom that we have as good earth without-side the garden as within; and lastly, the worst inconvenience is, it is an incitement for the roots of the trees to run downright, which is a very great fault in fruit-trees; besides, the roots can find but little nourishment under a brick-wall, where neither sun nor showers can come to give the earth a true bearing quality. I have seen a book in quarto, written by a Fellow of the Royal Society, who has taken some pains, in a mathematical way, to further the improvement of fruit, by building walls sloping, and has given some great proofs in his way, of the advantages attending such a wall; but I am sure he never made any practical experiments in this way, for had he so done, he would have been of another opinion.

I think

I think a perpendicular wall preferable to any other, or rather hanging a little inward over the fruit, if it could be conveniently contrived; for when the sun is low, either in spring or autumn, or in the morning or evening, then the slope walls which lean backwards, have but a glance of the sun's power; whereas a perpendicular wall has its full rays against it, which is preferable to the greatest heats of the sun at midsummer upon one of these back-sloped walls, for it is the sun in autumn we want to ripen our winter-pears, which require to be kept dry; but against these sloping walls they cannot; the dews lying there much longer than on the perpendicular ones; besides, they are much more liable to blights in the spring from the white hoary frosts, and are more exposed to the eddy winds on all sides.

What the ingenious Mr *Laurence* has said concerning the horizontal shelters for the safeguard of the blossoming trees, I approve of, and have experienced to be good; but I cannot help thinking but that the tiles he mentions will harbour vermin; and besides, it is difficult to lead a tree rightly among them; it is for that reason that I practise another method to save my blossoming trees from frost and cold dews: my way is, to have a couple of leaves of deal closely joined together, and well painted, and fix brackets on the top of the wall: then I have the deals to take up and down, putting them up in the spring, when the trees begin to blossom. These boards keep off the rain, dews and morning frosts, and by that means I have seen great crops of fruit when there has been hardly any elsewhere. As to the height of the walls, I would not advise them to be above eight or nine feet at most for pears; although it is the opinion of most gardeners, that unless the wall be twelve feet high, it is not fit for a pear; then they plant their trees so much the nearer, and run the branches perpendicular, which is a very great fault. First, in planting the trees

trees so near, they have not room for their roots to run: But if they were planted twelve or fourteen feet distant from one another, they would have the same room for the roots to run as the branches; and the branches being carried horizontally, fill the wall at bottom first, and so gradually upwards, till the whole wall is well filled with bearing wood. And next, concerning the disposition of pears, I would advise all winter-pears to be planted against the best south walls; I have seen in some gardens the best winter-pears planted against west walls, which I think is a great fault; as for summer-pears, and some autumn ones in espaliers, where I have had them, they do very well. As for preparing the soil, it has been my practice to make use of fresh earth from a good pasture-land, and not to mix dung and earth together; and I have found the success wonderful. Again, I never make my borders above two feet deep, but if the soil be deep or wet, I lay a good quantity of rubbish to keep the roots from running downright; and besides, the rubbish helps to drain the soil if it be naturally too wet, and keeps the roots dry, which is a great advantage to a fruit-tree. We must also observe that the roots be well exposed to the sun and showers, which is as necessary a care, as to see that the branches be well exposed to the heat. As for the pruning the several sorts of pears, I shall not trouble myself nor you about it, you having already given a very good account: but in the general, I would advise the pruning to be according to the strength of the tree, and to be sure not to prune too short, which causes the buds that otherwise would produce fruit, to shoot all in wood. What you find here worth transcribing, if you please to give yourself the trouble, will much oblige

Yours,

PHILIP MILLER.

C H A P.

CHAP. X. Of forcing fruit; or the method of making and ordering such a garden, as will bring fruits and herbs for table-use in uncommon seasons.

I Have been now about a twelvemonth collecting such examples in the way of forwarding and re-warding of fruits, as may give them to us in those seasons when nature is unactive among vegetables, or does not of her own accord produce any fruit; I mean the months of *November, December, January, February, March* and *April*. These months are stiled in *England*, the dead months, because there is then no fruit naturally growing upon the ground, though in countries nearer the equinoctial there are several excellent fruits ripe in these months, without any art; so much influence has the sun then in the southern parts, that they rejoice in their natural fruits when our gardens are vacant; unless by the help of art.

The methods which have been taken with us to ripen some few fruits out of their natural season, have been various, and but few of them successful; but notwithstanding the artists have failed of the perfection they aimed at, yet, if they have had any fruit at all, it has, for its bare appearance sake, in an uncommon season, so much recreated the minds of the curious, that it has been enough esteemed, to bring good profit to the gardener that raised it.

The sorts of fruit which I shall propose are, cherries of the early sorts, which bear well, viz.

The *May* cherry and the *May* duke-cherry.

The apricots are: the masculine apricot, and the *Bruxelles* apricot.

The peaches are: the avant-peach, the *Anne*-peach, the early *Newington* peach, the *Albemarle* peach, and the brown nutmeg.

The nectarines are : the early nutmeg nectarine, the alrouge nectarine, and the *Newington* nectarine.

The currans are : the large *Dutch* white, and the large *Dutch* red.

The gooseberries are : the *Dutch* white, the *Dutch* early green gooseberry, and the walnut gooseberry.

To these fruits we may likewise add two or three sorts of grapes, as

The white and black sweet-water, the large *July* grapes, whose berries are equal on the bunches, the malmsey, the royal muscadine, the red raisin, and the white fronteniack, of the right large sort, which are but in a few gardens in *England*.

These two last, though they are late grapes, will triumph over all the other sorts, and be early enough, by means of the force I shall prescribe for them.

All these may be planted against a paling of five feet high, made after the following manner.

The stakes to support this paling, must be set about six feet distance from one another ; to which must be nailed whole deal-boards of twelve feet long, well joined to one another, and plowed on the edges, so as to let in lathes, that thereby the steam of the dung, which is to lie at the back, may not get among the plants, for where such steam comes, it causes a mildew.

The deals if they are not quite an inch thick, will be apt to scorch the trees upon the first application of the hot dung, and if they are much thicker, the artificial heat applied to their backs by the time it begins to decline, will not be powerful enough to warm them through, and then the dung must be oftner refreshed.

Thus a paling of sixty feet long, will answer to five deals in length, and if it be somewhat above five feet high, will take up in all thirty deals.

When this is up, we may mark out a border on the south-side of it, about three or four feet wide ;
and

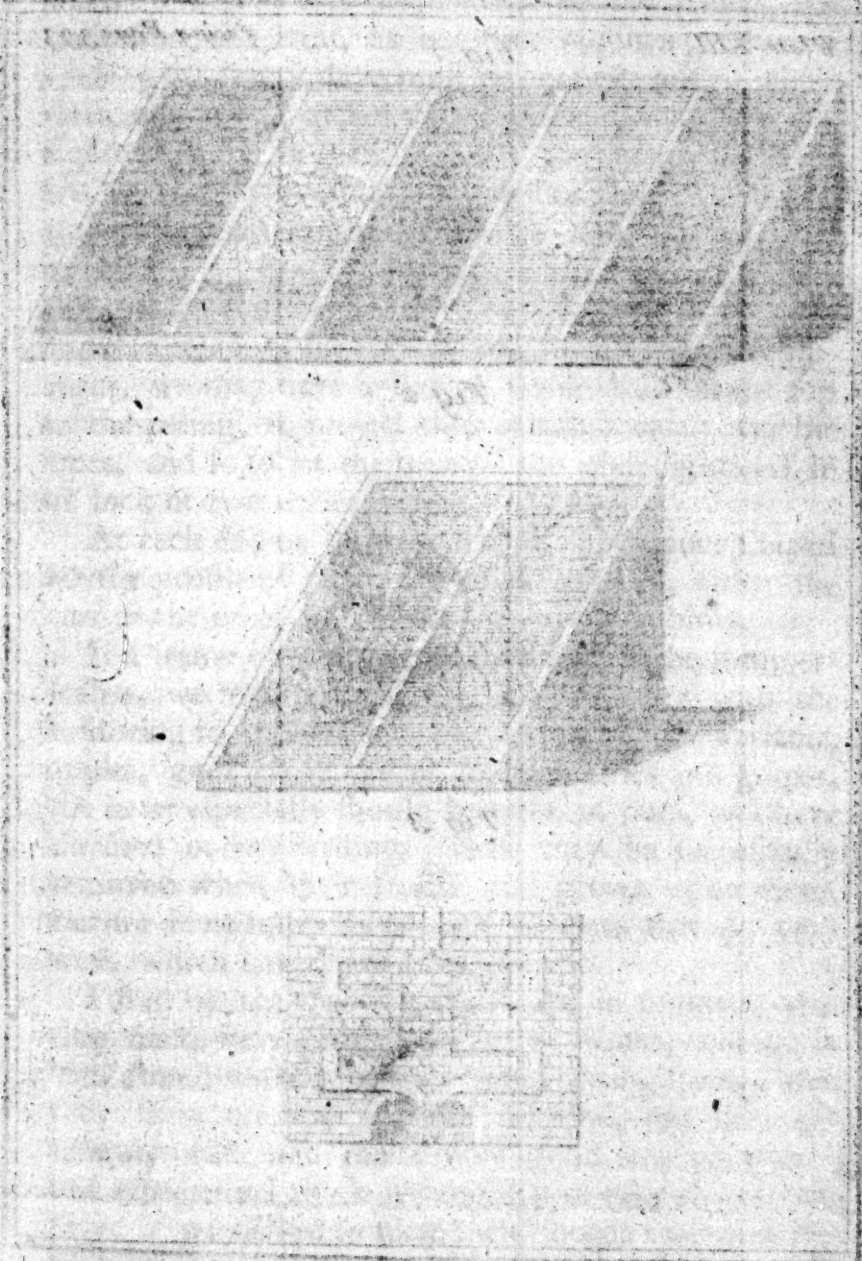


Plate XIII

Fig. 1.

facing Page 303.

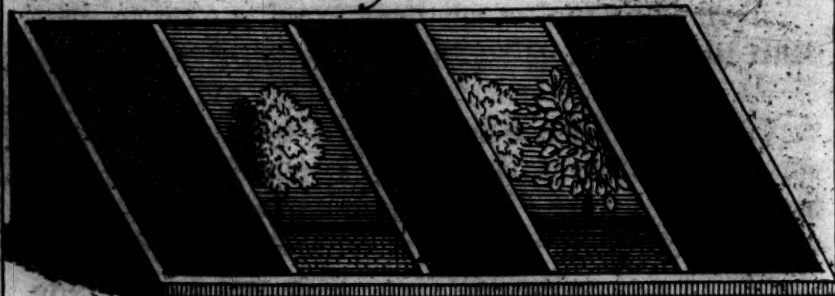


Fig. 2.

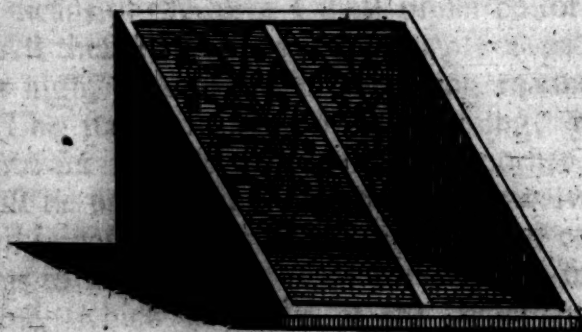


Fig. 3.



and on the outside of the border, we must fasten to the ground, in a straight line, some scantlins of wood of about four inches thick, to rest the glass-lights upon, which are to slope back to the paling, for sheltering the fruit, as occasion requires; between these glass-lights there must be bars cut out of whole deal, about four inches wide, so made, that the glass-lights may rest in them: these bars must always remain fixed, as in a frame for a hot-bed; but the figures will explain the manner of these frames more easily to us. See *Plate XIII. Fig. I. and II.*

If we have a mind that the glass-lights should not slope so much as they must by this fall from the upright, we may have a line of whole deals on the top of the paling, to project their whole breadth over the trees, and so to let the tops of the glass-lights fall in an inch or two under them.

At each end of this frame must be a door shaped to the profile of the frame to be opened, either the one or the other, as the wind happens to blow.

If a frame of this nature be made in the summer-season, we may plant it the same summer with the following fruits, peaches, plums, nectarines, apricots, apples, gooseberries, pears, figs, cherries and grapes, the latter especially should be raised in pots, as I have directed in my writings; these may be successfully removed when their fruit is full grown upon them, but we have instances enough of trees that do very well, which have been transplanted.

I find by the planting these trees in summer, that they make very good roots before winter, and are so well stored with sap against the following spring, that they shew no sign of their removal, but bear extremely well, and make very good bearing wood; and especially I think it necessary to take this advantage, if we design to force them sooner than ordinary to blossom; because, unless the roots are well furnished, the fruit cannot be sufficiently nourished; besides,

Sides, by this summer-planting, the trees seldom or never throw away their strength in autumn shoots, or make any attempt towards it, till the frosts in *September* and *October* stop their design.

If we cannot have an opportunity of planting these trees till we are just going to use them, take the peaches and such like from walls of three years growth, and by removing them carefully, and planting them in mud made of fine earth and water, they will presently begin to shoot; if we apply the heat to the back of the frame even, so as to be in blossom a fortnight after planting, the grapes or vines having been brought up in pots to bear the preceding year, will likewise answer your design very well, but they require more time to make their shoot, than the peaches and plants of that kind.

I find by experience that we hurt our trees, if we apply our heat before *November*. And I find likewise, that about the middle of that month, or towards the end, is time enough to bring us ripe cherries, both duke-cherries, and those called *May* cherries, early in *February*: and at the same time likewise, the heat may be used for apricots, so as to make the masculine apricot as large in *February* as duke-cherries, and ripen them the beginning of *April*.

vii Apricots, though forced in this uncommon season, will thrive and prosper well for many years; but cherries do not seem to bear this alteration in nature so well as the apricots; however, I have known them hold seven years in good plight.

o Some of the forward sorts of plums have been tried, and ripen about the end of *April*; and I have tried also the imperial plum, which though it is a late ripener naturally, in this case does wonders: I judge that the *Anne* peach would be ripe about *April*; and the early nutmeg-nectarine, which is a great bearer, would, in my opinion, ripen much about the same time with the masculine-apricot, if they were to be

both

both forced together; and the blugnion nectarine would soon follow.

The goosberries, which are of themselves apt to bud out early, will undoubtedly, by this means, be brought very forward, that is, to have green fruit fit for tarts in *January* and *February*, and ripen about the end of *March*, or beginning of *April* at farthest, as I have experienced. And although there is a way of preserving green goosberries all the year round, yet we find so great a difference between the preserved-goosberries, and those fresh gathered from the trees, that the price of the latter is eight or ten times more than that of the former.

The curran likewise, which tends to shoot forward, might, by that heat which brings the cherries in *February*, be forced to ripen its fruit in *April*, or sooner; for naturally the heat or temper of air which ripens the *May* duke-cherry, brings the curran so forward in its fruit, that it is hardly three weeks later than the cherry in ripening its fruit; but we should have an especial care to plant our currans and goosberries a year beforehand, if we design to force them.

We might also plant a row or two of strawberries, close to the back of this frame, and they should be of the scarlet-kind: we may expect from these ripe strawberries at the end of *February*, or beginning of *March*.

The vines likewise which I have mentioned, may be brought to blossom in *February* or *March*, and have ripe fruit in *May*.

Among this fruit we might here and there have a monthly rose-tree, and the border might be planted with early tulips, hyacinths, junquils, and narcissus polyanthus, and then the monthly production of this frame would be, in *December*, hyacinths and some tulips.

January. Hyacinths, tulips, and green-goosberries, cherry-blossoms, strawberry-blossoms, apricot-blossoms,

blossoms, peach-blossoms, plum-blossoms, and the young rose-buds beginning to appear.

February. Some of the later tulips, junquils, narcissus polyanthus, roses, green-goosberries, green-apricots, ripe cherries, green-peaches, green-plums, and towards the end, a few ripe strawberries: likewise we may then expect the vines to put out their blossoms, and the currans to be pretty large.

March. Tulips, roses, junquils, narcissus, duke-cherries, strawberries, green-goosberries, green-apricots, green-plums, and about the end, perhaps, if the weather be favourable, some currans beginning to turn, and some small green-grapes.

April. Roses, strawberries, the masculine-apricot ripe, some duke-cherries yet remaining, ripe goosberries, ripe currans, and about the end, some early plums, and the early nectarines; and peaches so forward as to ripen at the end of this month; and also the grapes so much forced as to ripen the next month, and about the end of it to be in full perfection.

But I come now to speak of the method of planting, pruning and ordering these fruit-trees, so that they may give us such rarities in the months I have promised them; and first, of the planting them.

We are to understand, that contrary to what we have said of planting trees against walls, these trees must be planted close to the paling; for though I advise to plant wall-trees with their roots at a little distance from the wall for their better nourishment, the case here is very different; for the roots will run under the pales, and draw nourishment equally from the earth about them; but the foundations of walls lie too deep in the ground to suffer the roots of fruit-trees to draw nourishment from the wall-side.

Again, in such a frame we need not plant our trees at a greater distance than four or five feet; or at proportionable distances, according to the shoots they have upon them; if they had been trained in espalier,

or

or against walls, two or three years beforehand, it would not be amiss, because of filling our frame more speedily with bearing wood. For my part, I should not scruple removing trees that had stood seven or eight years against walls, rather than want those that are bearers for these forcing frames; or if they were of a much greater age, they may be safely transplanted by the new method which I have prescribed in this work.

The gooseberries, currans and roses, will serve to fill up the small spaces at the bottom of the paling, while the cherries, apricots, peaches, nectarines and plums, occupy the higher parts of the pales.

When we come to the pruning of these trees, we may follow the same method of pruning the several sorts that I have recommended before in these papers; but the time of pruning and nailing must not be the same, for this reason: in the forcing frames, our spring begins in *November*; but in the common case of stone-fruit against walls, the spring does not begin till the end of *January*, or in *February*, and there we leave our trees unpruned, till the spring begins to stir, lest the frosts should damage them, and also that they might not be wounded till they had strength enough, and a favourable temper of air to grow freely, and help their wounded parts. Now as the case is with the trees against the paling, where the spring begins in *November*, and the air is so tempered by art as to set the trees a-growing, and no frosts can come at them, I have found it necessary to prune such fruit-trees about a week before I began to apply any heat, and put up all the glasses as soon as they were pruned.

In the nailing the trees to the pale, every branch and shoot should lie as close as can be to the pales, for there will be a month's difference between the ripening of the fruit which touches the pales, and that which lies two inches from them; nor in these frames does the fruit, which grows next the root, always
ripen

ripen first: I have seen the tops of the trees have blossoms and fruit, a month or six weeks sooner than the bottoms; sometimes a branch has been full of blossoms, when ten or a dozen more, growing upon the same tree, have not stirred till the fruit of the first blower has been almost ripe, and yet the tree has done very well; so that it is not uncommon for such trees to have fruit ripening upon them near three months.

Now, as for the gooseberries, we should pick out such plants as will spread; and besides laying as many shoots to the paling as we can conveniently, we may leave others at a distance from the pales, to follow the first in fruit. I observed before, that we may make them bear the first year, as well as if they had not been transplanted, if they are taken up in the summer, and managed after my new method; the currans may be ordered in the same manner, as well as the roses. But we must remember, that the best sort of rose for this purpose, is the cluster monthly rose; and these roses should always be topped about the end of *July*, or beginning of *August*, to make them sling out a great quantity of flower-buds, when we apply the heat to the pales.

We now come to consider the manner of laying the hot dung to the back of the pales, and what proportion of air these plants require while we are forcing them.

The dung which is designed for this use, ought to be tossed up in an heap some days before it be laid to the back of the pales, that it may yield a heat every where alike, and be constant. When it is fit to apply to the pales, we must lay it four feet wide at the base, and let it slope to two feet at the top, the height in all should be at first equal with the top of the pales, and in six weeks time it will sink about a foot and a half; and then we must apply some fresh dung to be tossed up with the former, which will bring our trees into full bloom, and set some of the fruit; but this happens

happens to be sooner or later, as the frost has had less or more influence over the buds. It helps very much to forward the blossoming of these trees, to cover them with the glass-lights, when the frosts happen; for though the frosts will not destroy the blossoms, yet the more the frost comes at them, the drier they will be, and the harder they will be to open. It must be observed likewise, that no opportunity of showers be denied them, if the weather be tolerably mild, till the buds begin to stir; but, after that, let the glasses remain over them constantly, till the sun begins to have some power. In the mean while, let the doors at each end be opened when the sun shines warm, and the wind is not too sharp; and if this does not happen during the space of fourteen days, then open the doors at both ends, and put up mats of bafs or canvas over the door-ways, to correct the winds, and cause the air to circulate in the frames.

About three changes of dung will go near to bring our cherries ripe in *February*, allowing each parcel to remain a month at the back of the pales; but if *April* proves cold, we must continue our forcing heat till the weather in *May* is settled, for our plums, peaches, nectarines, apricots, and grapes; and while these last fruits are growing, as they will be in *March* and *April*, open some of the glasses in the mornings when the sun is warm and the winds still, and give them such gentle showers as happen to fall; but never let the rain come at them when they are in blossom, for it is plain from experience, that when the rain falls upon the blossoms, before they are set for fruit, they will rarely come to any good.

Now where forcing frames of this kind are kept, the dung, when it has lost its heat, may be laid into heaps to rot, for the benefit of stubborn grounds. And we should observe, that when we plant these frames, we should plant such fruits as come forward together; and the latter fruits by themselves; for
when

when the forward fruits have done bearing, it would be prejudicial to them to give them any more heat, as they must have, if they are promiscuously among the late fruits, which perhaps may require artificial heat till *May*.

To render this sort of frame still more pleasant and useful, we ought to have one, which, besides the fruits already mentioned, should have its border chiefly disposed for bringing forward pease, beans, cabbage-lettuce, young fallads, kidney-beans, some artichokes, cauli-flowers, nasturtium-flowers, and early mint.

The produce then of this frame will be in *November*, cabbage-lettuce, mint, and young fallads.

In *December*. Mint, young fallads, cabbage-lettuce of several sorts, and green pease.

In *January*. Mint, young fallads, cabbage-lettuce, and green pease.

In *February*. Mint, young fallads, cabbage-lettuce, beans, some green cauli-flowers, and artichokes.

In *March* we have these continued, and about the end of *April* we have kidney-beans, and nasturtium-flowers, besides the fruits, as in the other frames.

To bring cherries in *December*, it has been a practice to pull off all the blossoms of a tree as soon as they appeared budding out in the spring, and to keep the tree very dry from rains all the summer; and about the end of *July* or in *August*, to give it gentle waterings, by little and little; so that about the end of *September* it has been full in flower; we must then keep the glasses over it, and about the end of *October*, if the weather be cold, or beginning of *November*, we are to apply the dung to the back of the pales, and give fresh dung once a month; thus we may expect ripe cherries in *December*.

If we have two of these frames, they should stand about twenty feet a-part, for the greater freedom of the air; and that the sun may have the opportunity of warming the ground in the front of the back frame.

We

We should likewise provide some beds of strawberries, chiefly of the scarlet kinds, to bear fruit in *September* and *October*; and the hautboy-strawberry likewise, will bear fruit at that time of the year; but all these must have their blossoms pinched off in the spring, as soon as they begin to appear, and the plants must be kept dry, till about the middle of *July*, and then gently refreshed with water.

Now, as I am come to speak of hot-beds (a), I cannot avoid mentioning a very curious contrivance of

(a) Hot-beds are of general use in the northern parts of *Europe*, without which we could not enjoy so many of the products of the warmer climes as we now do, nor have our tables furnished with the various products of the summer so early in the spring.

The common hot-beds, used in kitchen-gardens, are made with horse-dung in the following manner: a large quantity of new dung from the stable, with the litter among it, should be mixed with some sea coal-ashes, and when it has stood a week, it will have acquired a considerable heat. This dung is then to be placed in a shallow trench, made in a sheltered part of the garden, and if it be intended for the planting out of melons or cucumbers, there must be made, at proper distances, where the middle of the light of the glass they are to be covered with will come, holes of ten inches over, and six deep, which must be filled with fresh earth, thrusting a stick in the middle, to shew the place where the hole is. The whole bed is then to be covered about four inches thick, with the earth taken out of the trench. When this is done, the beds are to be covered with frames of wood, fitted with lights of glass, and after about two days the earth will be of a proper degree of warmth to receive the plants to be set in it.

In the making these beds, great care must be taken to lay the dung close and even; and if it be full of long litter, it should be trod down, otherwise it will heat too violently, and the warmth will be soon dissipated. For the first ten days the glasses must be but slightly covered in the night, and in the day-time carefully raised to let out the steam, which is subject to rise very copiously while the dung is fresh. Afterwards the covering must be increased, and if the bed cools

of an ingenious gentleman, *Samuel Molyneux*, Esq; which will, in my opinion, be of great use in gardening, and take up very little room: there must be a
frame

too fast, new dung must be laid about its sides, which will give it a great warmth throughout, and by that time this is dissipated, the sun's rays will have power enough to supply the place of artificial heat. Only, at this time, if the nights happen to be cold, as is indeed often the case, it will be necessary to lay some mowings of grass about the sides of the bed.

This is the sort of hot-bed most in use in kitchen-gardens; but those made with tanners bark are much properer for the tender exotic plants and fruits, which require a steady and equal degree of warmth to be kept up for several months. In order to the making of these, a trench must be dug in the earth, about three feet deep, if the soil be dry; but if it be wet, it must be only dug one foot, and the bed raised two feet above ground. The length must be proportioned to the number of frames it is intended to be covered with, but it should never be less than eleven or twelve feet, nor its breadth less than six, this being absolutely necessary to there being a body of bark enough to keep up the heat. This trench is to be bricked up to the height abovementioned, and in the spring should be filled with fresh tanners bark, that is, such as the tanners have lately drawn out of their vats, after having tanned leather with it. This should be laid in a round heap for two or three days before it is put into the trench, that the moisture may run off. It is then to be put into the trench, and gently beat down with a dung-fork. It must then be covered with a wooden frame and glasses, and in about ten days it will begin to heat, and is then fit to have the pots of plants and seeds plunged into it.

A bed of this kind will continue in a good temper for warmth, six months; and when the heat declines, if it be stirred up thoroughly from the bottom, with a fork, and a load or two of fresh bark added to it, will recover its heat, and keep it for two or three months longer.

The frames that cover these beds should be proportioned to the plants they are to contain; if for the pine-apple, the back should be three feet high, and the lower part fifteen inches. If the bed be intended for taller plants, the frame must be higher in proportion; but if meant only for sowing
of

frame made of wood, in the manner of a hot-bed frame, suppose about a yard long, and two feet over, with a glass-light to cover it, and wired at bottom, so as to hold a sufficient depth of earth, for the nourishment of the plants it will contain.

We are then to provide a box of the same length and breadth, and about ten inches deep, to be filled with sand, for the frame to stand upon, the bottom of which box is to consist of a thin iron-plate. Thirdly, we must cause a box to be made of iron-plate, proportionable to the box of sand, so deep that a lamp may burn in it; and at one end of this box there may be an outlet for the smoke, to be used as we see occasion. Upon this iron-box, which may be made to move upon wheels or rollers, we are to set the box of sand, and upon that the frame of earth; I suppose the iron-plate at the bottom of the box of sand may serve for the top of the iron-box where the lamp is to burn.

If we consider that such a body of sand will hold an heat for eight or ten hours when it is once warmed through, we need not keep the lamp always burning; but there may be a thermometer placed in the earth, within the frame, to shew us when the lamp may burn, or when it may be put out; and a little experience will inform us of the just quantity of oil necessary to be expended. In my opinion, heat may be regulated to any degree we desire, by this invention; if it is too moderate, we may take away some of the sand, and if too violent, we may add more: Besides, we may move this hot-bed from place to place; that is, it may stand abroad in fair weather, and be sheltered in a green-house when the weather is very sharp and frosty.

D d 2

But

of seeds, it need not be more than fourteen inches high at the back, and about seven inches deep at the front. *Miller.*

But in the moving it from place to place, I think it advisable to fix its face always to the south, and not, for the sake of getting a little sun, change it sometimes to the east and west: for it is the nature of plants always to stand still, and never to change their face from the point they were first directed to; and this has been so much regarded by the old planters, that they direct us, when we plant trees, to set always that side of the tree which stood towards the south, as exactly as may be, to point the same way; and even among the smaller plants, I think it is reasonable to do as much, for they are under the same law of nature.

There are two or three things more I shall mention relating to this garden, before I speak of the walls which are to inclose it. The first is, the method of bringing beans to bear early with safety, and without the use of hot-beds. When we set our beans for a forward crop, we should put a good quantity of them into such places, as may be covered with such frames as are used for hot-beds, when the frosts begin; and by that means, if all those that stand abroad should be destroyed by severity of weather, we may plant out those which have been preserved under the frames in their places, and they will prosper very well, and bear plenty of beans, if they have not been too much confined, or have not been drawn too much under the glasses; for then they would be tender in the stalk, their joints wide, and their fruit weak, and few in number. I have tried this with good success; and whether the plants of beans have been sheltered or not, they may be transplanted very well in the spring, though they are four or five inches high, and even in *May*, if we cut them down within two inches of the ground, a week before we transplant them.

The next thing is, to sow cucumbers the beginning of *May*, in drills; the seeds may be set about ten inches asunder, and the drills may be a foot a-part.

When

When the cucumbers have made their second leaf, set a tile of brush-wood stakes about five feet high, between the lines of the cucumbers, and they will run up these stakes of their own accord, and bring very good fruit till the end of September, and even in October. We may remark, that cucumbers thus raised without transplanting, if they have the liberty of running up stakes, will not be subject to the rot or canker, as I have found by experience.

Lastly, we should have in this curious garden, conveniences for raising of the ananas or pine-apple, such as are described in this treatise. Thus having gone through what I proposed in describing the frames for forcing of fruits, flowers, &c. out of their wonted seasons, I come in the next place to inform my reader of the method for building the walls which should partly inclose this garden; and these may be so ordered, that we may forward the fruits planted against them as we shall see convenient. I shall be the more particular in my description of these, because it is not every where in England that we can find hot dung enough for hot-beds; and there are many countries where coals are in such plenty, that the expence of warming walls of several hundred feet long, will scarce amount to thirty shillings per annum; for the smallest coal, such as is generally counted good for nothing, except mending the highways, will do for this use.

The walls I speak of should be exposed to the south sun, for walls lying to the east, west, and north aspects, as they are not sufficiently in the sun's way to bring fruit forward, so they may be built after the common manner.

The walls then, which lie to the south sun, should be built eight feet high, with fire-places at the back, at twelve or fourteen feet distance from one another. From each of these should run a flue of nine inches square,

* See Chapter XIV. following.

square, parallel with the border, about four feet and a half from the center of the fire-place; and then rise in an upright, about a foot and a half, and be returned towards the peer over the fire-place, parallel to the first, and rise to an upright as before, to be returned back again in course with the first: these turnings of the flue must be continued till it comes near the top of the wall, and lets its smoke out at a chimney over the fire-place. We are to remark, that these sort of flues may be carried both from the right and left of a fire-place, and by that means the fires being about twelve feet distance from one another, the whole wall may be regularly warmed at once, if we think proper; or about ten or eleven feet of wall may be warmed at a time by one fire only.

The border on the south-side may be raised so high as that the earth may lie against the bottom flue, to be warmed the better.

This wall should be two bricks thick, for the better forming the flues, as well as for its strength; and for the better regulating the flues, and for the greater ease of the builder, there should be made on purpose tile-bricks of eighteen inches and a quarter long, nine inches and a quarter broad, and two inches and a quarter thick, which will at once cover the flues, and reach the whole thickness of the wall. Now considering the space which will be vacant in the flues, such a wall will hardly take up more bricks than a wall of a brick and a half thick.

When this is done, we must provide frames and glasses, in the manner of those used against the paling I have already treated of, only with this difference, that if we have a mind to force a single tree, only that part where the tree is, may be covered with glasses, and shut up.

The border may be four or five feet wide; and if the glasses were to be set upright, and a covering of sloping glass from those to the wall, one might then

have

have room to walk within-side. By the help of this contrivance, we may have every thing mentioned in the forcing frames as above; and one might add carnations too, to be kept blowing all the winter, and the *Spanish* jessamine; and if they were nailed against the walls, they would open their flowers very large.

But these walls would likewise be extremely useful, to forward our late kinds of grapes and pears, and with good management, might in a manner place us in as warm a climate as thirty degrees latitude. And besides, here our crops of fruit would never fail us, if the trees were in a blossoming condition, and were well pruned; and the advantage that might be gained by the extraordinary number of fruit, and its superior excellence, would very soon return the expence of the glass-frames, and the trouble of making fires.

The pears which we should cultivate against such a wall, should be those that are brought to table in the winter, as the colmar, bon chretien, &c. which want sun in our autumn, to give them their true flavour; so that if we force them to blossom about six weeks or two months sooner than usual, we may be sure to have their fruits as excellent as they are any where in *Europe*.

The grapes which might be helped by these walls, are all the sorts of frontiniacs, the raisin-grape, and every other sort of late grape, even the canary grape, only by bringing them to blossom in *March*; there would then be summer enough for their growth and good ripening; but against this wall also, we must not forget to have some of the forward sorts of grapes to ripen about the end of *May*, as they have done already in *England* by such means.

To conclude, I shall insert a method of making a hot-bed by means of fire, for the service of those gardeners who have but little opportunity of getting hot horse-dung; this I learned from Mr *Benjamin Whitmill*. He prescribes, to make a frame of brickwork

of any length, but as wide only as a common hot-bed, to have a fire-place at one end to pass into a flue, which shall wind from side to side till it reaches the other end; and discharges its smoke by a chimney; the top of these flues may be covered with square tiles, or such tile-bricks as I have mentioned before; and when the intermediate spaces between the flues are filled with coarse sand, cover the whole with square tiles, and raise the wall about ten inches above the pavement, so that we may cover the pavement as deep with sand, if we see occasion; then upon this sand place such frames as are commonly used for hot-beds, with wire at the bottom, to hold the earth in them, that the earth may receive the heat of the sand: and, I am of opinion, it may be as useful as any hot-bed, and be more lasting and less troublesome.

We may see the method of the flues for the great wall in *Plate Ibid. Fig. III.*

Since I have written this, I have learned from the curious Mr *Dubois* at *Mitcham*, somewhat more than I have yet related, concerning the production of pease in the winter: that gentleman informs me, that he gathered pease this winter, from about six plants which were sown in a pot late in the autumn, and that had stood exposed abroad for some time, and sheltered, during the rude season, in the conservatory; they were of the second dwarf pea-kind, which bear plentifully, and were trained upon sticks; the pease gathered at one time, yielded, when they were shelled, about half a pint, which turned to good account, considering the ground they took up; and I think it would be an agreeable amusement for such as have conservatories to cultivate either this sort of pea, or the smallest dwarf in pots, so as to have them all the winter, without any extraordinary trouble.

This curious garden should have one part of it disposed for mushroom-beds, after the manner I have already directed in this work.

CHAP.

CHAP. XI. *Concerning blights, with remedies against them, in two letters to the author; and concerning the method of helping decayed trees, and bringing distempered ones to perfect health.*

To Mr BRADLEY.

SIR,

I Received yours, and should be glad to inform you of any thing worth inserting in your books. As for preventing of blights, I cannot say any thing to that, but I have recovered several fruit-trees, as cherries, dwarf-apples and plums; as also cabbages, and other garden stuff of that kind (after the fruit and plants were blighted and began to wither) by a water made with tobacco-stalks; I watered the trees with the said water, and in a very short time the leaves and fruit began to recover, and grow to their full perfection. This tobacco-water hath recovered those that were watered with it; and it is a question whether those that were not, will live to bear another year.

I have had two years experience of this water with great success, and find it answer beyond any thing that I ever made use of. I chiefly found this out by a man that chewed tobacco, who spit upon whewt, and a toad, and thereby destroyed them; from whence I supposed it a great destroyer of all sorts of vermin.

I made two hogheads of water, by infusing six or seven pounds of tobacco-stalks, though one may add more as occasion serves. I am now trying another ingredient, which I find to be a great destroyer of insects, which, Sir, if it should prove effectual, I shall be glad to oblige you with.

I am, SIR, &c.

JAMES BRUSSARD,

The use of tobacco, in such cases, has long been practised with success, to destroy the insects that infest plants, by strewing tobacco dust upon them, and by making a fumigation of it under trees; so I doubt not but the infusion of tobacco-stalks in water will answer the end full as well, and may be done with less trouble.

S I R,

I am situated in a country near a petre house, as we call it, or in other terms, a house where such salt-petre as is brought from abroad is boiled and refined for gun-powder. This place is so near me, as to communicate the steam of the nitre, when the people are at work, to the greatest part of my orchard and garden, and, in the opinion of some, is injurious to my trees and plants; but however my orchard is influenced by it, we are certain that it never fails to bring me a very plentiful crop of fruit every year, though all those about it have very little or hardly any; and yet my garden is not less exposed to blighting winds, by its natural situation, than the other orchards in the same town. If I may therefore judge from the consequence, the nitrous vapour, which mixes with the air, that surrounds my garden, prevents blights, and is noxious to the caterpillar. I remember Lord Bacon, in his *Natural History*, commends the use of nitre for the preservation of human bodies in health; and most of the skilful botanists have given it no less a character for the preservation of vegetables, if its quantity be rightly proportioned. Now, as I take it, the air, which is supposed to bring blights, is in itself thin and very quick of motion; and therefore the nitrous fumes, raised at one end of my garden, cannot mix with such air in too great quantity, by means of its thinness and quick motion, for the nitrous vapour has much grosser particles than the fine air which moves with it; and the quickness of motion of the fine

fine air may drive before it the fumes I mention, with that velocity, that there cannot lodge too much of it upon my trees; and thus mixing indifferently with the air, may put that air into such a state, as may (agreeable to an observation of yours) contribute to the destruction of insects or their eggs, which are the blights in trees. Or if nitre is allowed to be salubrious to trees, and keep them in strength, then I remember a maxim, that a body duly supported by natural diet is not capable of admitting any distemper, but on the contrary resists it: this alludes to what I have before-mentioned, that nitre in its due quantity is a preserver of health in plants, and more particularly because as you say in some of your works, that a state of air well regulated and appointed in its qualities, is received as well into some parts of plants, and causes their healthful disposition, as a case of that kind would do when the animal kingdom is the subject. It is for reasons of this sort that I suppose my orchard is not so subject to be blighted as the rest in our town, which have not the same benefit from the vapour of the salt-petre (a).

I should

(a) Blights are often caused by a continued dry easterly wind for several days together, without the intervention of showers, or any morning dew, by which the perspiration in the tender blossoms is stopped; so that in a short time their colour is changed, and they wither and decay: and if there happen a long continuance of the same weather, it equally affects the tender leaves, whose perspiring matter becomes thickened and glutinous, so as closely to adhere to the surfaces of the leaves, and become a proper nutriment to insects, which are always found preying on the leaves and tender branches of fruit-trees, when this sort of blight happens, though it be not the insects which are the first cause. The best remedy yet known, is gently to wash and sprinkle over the trees from time to time with fair water; and if the young and tender shoots seem much infected, to wash them with a woollen cloth, so as to clear them, if possible, from this glutinous matter, that their respiration and perspiration may not be

I should be glad to know your sentiments of this matter, and am,

SIR, *Your humble Servant,*

A. B.

Concerning

be obstructed. Add, that broad flat pans or tubs of water being placed near the trees, which may receive the vapours exhaled from them, will help to keep their tender parts in a ductile state; but whenever this operation of washing the tree is performed, it should be early in the day, that the moisture may be exhaled before the cold of the night comes on, especially if the nights are frosty; nor should it be done when the sun shines very hot upon the wall, which would be subject to scorch up the tender blossoms.

Another cause of blights in the spring is sharp heavy frosts, which are often succeeded by hot sun-shine in the day-time, which is the most sudden and certain destroyer of fruits known; for the cold of the night starves the tender parts of the blossoms, and the sun rising hot upon the walls before the moisture is dried from the blossoms, which being in small globules, doth collect the rays of the sun, and thereby scorch the tender flowers and other parts of plants.

But that blights are frequently no more than an inward weakness or distemper in trees, evidently appears, if we consider how often it happens, that trees against the same wall, exposed to the same aspect, and equally enjoying the advantages of sun and air, with every other circumstance which might render them equally healthy, are often observed to differ greatly in strength and vigour; and as often do we observe the weak trees to be continually blighted, when the vigorous ones in the same situation escape. This weakness in a tree proceeds either from want of a sufficient supply of nourishment to maintain it in perfect vigour, or from some ill qualities in the soil where it grows, or, perhaps, from some bad quality in the stock, or inbred distemper of the bud or cion, which it had imbibed from its mother-tree, or from mismanagement in the pruning, &c.

But there is another sort of blight, against which it is more difficult to guard fruit-trees; that is, sharp, pinching, frosty mornings, which often happen at the time when the trees are in flower, or while the fruit is very young, and occasion

the

Concerning the helping decayed trees, with a method prescribed for bringing distempered ones to perfect health.

So useful is the discovery of the sap's circulation in plants, that without that knowledge, there could be no reasonable method prescribed for the cure of distempers in trees (*b*), or for the renewing vigorous growth

the blossoms or fruit to drop off; and sometimes the tender parts of the shoots and leaves are greatly injured thereby. The only method yet found out to prevent this mischief is, by carefully covering the walls, either with mats, canvas, &c. which being fastened so as not to be disturbed with the wind, and suffered to remain on during the night, are to be taken off every day, if the weather permits.

Another sort of blight, which sometimes happens in *April* or *May*, and which is often very destructive to orchards and open plantations, and against which we know of no remedy, is what is called a fire blast, which in a few hours hath not only destroyed the fruit and leaves, but many times parts of the trees, and sometimes whole ones have been killed by it. This is supposed to be effected by volumes of transparent flying vapours, which, among the many forms they revolve into, may sometimes approach so near to a hemisphere, or hemicylinder, either in their upper or lower surface, as thereby to make the beams of the sun converge enough to scorch the plants, or trees they fall upon, in proportion to the greater or less convergency of the sun's rays. This more frequently happens in close plantations, where the stagnating vapours from the earth, and the plentiful perspirations from the trees, are pent in, for want of a free air to dissipate and dispel them; than in those planted at a greater distance, or surrounded with hills or woods. *Miller.*

(*b*) In the distempers of trees some are in the tree itself, and others in the soil and other things about it. Of the last kind are weeds, which are of the utmost ill consequence to all sorts of trees while young, and should be pulled up by hand after rain: if they are too strong rooted for this, they must be dug up; and this will have a double advantage, as the stirring the earth about their roots will do the trees very great good. When the trees are grown to any tolerable height, they require no care about weeds, for they kill them with

growth in such as are decayed: this is not only good in theory, but is excellent in practice, as I experienced in an operation upon some old dwarf pear-trees, that ~~that without their know-ledge, there could be~~ were

with their own droppings. Suckers are another distemperature of trees arising from the tree itself: they must be pulled off, or cut up close to the place where they come out, opening the earth to come at them there. Over-much wet often is a very great prejudice to trees, and especially to those kinds which naturally love a dry soil. This is to be remedied by cutting drains: and if a drip fret the body of the tree by the head (which will certainly decay it) the place must be first cut smooth, and then some loam or clay, mixed well with horse-dung, is to be applied to the place, which will defend it from mischief till a new bark is formed over it. All wounds made in trees in winter are much harder to cure than those made in summer; and for these it is proper to add some tallow to the mixture of loam and dung. When trees are bark-bound, which is easily seen by the unnatural tightness and straining of the bark over them, it is to be remedied by cutting through the bark with a knife from the top to the bottom of the tree. This may seem a dangerous remedy to those who have not experienced it, but it never was found to do any injury to trees. It is to be done in *February* or *March*; and if the wound gape very much, it may be filled up with cow-dung, which will defend the tree from injury till it heals. The digging about the root of the tree is a very good practice also on this occasion, and the cutting off the dead or withered branches. The grubs of beetles, called teredines and colli, which get between the bark and the tree, do great mischief; if the places can be found out where they lie, it is proper to pierce into the bark with a pointed instrument upon them, and then to open a small hole below to let out whatever moisture may be there. When trees of the fruit kind are burnt up and blistered on the bark with hot and dry seasons, and this is followed by a vast number of the pucerons or tree-lice, which feed on the juices, some recommend the boring a large hole in the main root, and pouring in some brandy, then stopping up the hole with a pin of the same wood. The tree suffers nothing by this; but the juices are so much altered for the present by it, that these animals do not like them, and consequently quit their habitation.

Mortimer.

were reduced to so great weakness, that their fruit, which should have weighed nine or ten ounces a-piece, was hardly bigger than hazel-nuts. Some of the trees were cankered a little above the roots; their shoots were poor and sickly, and I had so little hopes of their recovery, that I hardly thought it worth while to employ my labour or time about them; however, that I might not quite lose some of their kinds in their death, I contrived to inarch some of their best branches into free-stocks, which I had by me at that time in good quantity.

About the end of *August* I picked out of my nursery about fifty of the largest pear-stocks I had, most of which were in the thickest part two thirds of an inch diameter; these I carefully transplanted at certain distances from my sick trees, contriving always to have every stock within an easy reach of one of the best branches in my old trees.

The care I took in removing my stocks gave them little or no check, so that the following spring I inarched several branches of the old trees into them; to one old tree I had five stocks, to another four, and some had only two a-piece. Most of my inlayed grafts or inarched shoots were perfectly joined with the young stocks in less than three months; and as several of them blossomed in the spring, the supply of good juices from the young stocks, which they were grafted into, so nourished the fruit that set upon them, that I had several pears even larger than I had observed before upon the old trees when they were in health; and the branches of the old trees nearest to every stock strengthened themselves, as did also in proportion every part of the old trees.

When the fruit was fit to gather, I happened to be travelling, which was the occasion that the inarched cions were not then cut from the old trees, but luckily remained all growing together. The following year, to my surprize, the old trees had got so much vigour from

from the strong juices of the young stocks which circulated through them, that they had all the juvenile appearance and healthful disposition of a young tree: they shot with so much strength, that I then began to fear they were in danger of losing their bearing quality; and therefore I sawed the main stem of one of the old trees more than half through, and drove a wedge into the wound, which yet did but little good in checking the vigour of the tree; so that I was obliged to cut the old tree entirely from its root, leaving it only the young stocks to feed on, which it did with so much advantage, that it grew well and produced good fruit.

The other old trees were all equally invigorated by this practice, so that I was forced to cut off their communication with some of the young stocks, and thereby abridge their over luxuriancy, which is always an hindrance to bearing: by this means the trees become more gentle in their vegetation, and disposed themselves to blossom and bear fruit. But I saw many inconveniences which they would yet be subject to, by being treated in the manner of dwarfs; as, that pear-trees had three different modes of giving us bearing branches; some kinds would bear upon wood of one year, others of two years, and others of three years old, so that it was difficult to keep some of them in a regular figure, and expect fruit from them; and besides, that every gardener was not either apprised of this in general, or else was not experienced in the particulars, which sorts would blossom on one year's, which on two years shoots, &c. and to prune all alike, would lose a great deal of fruit.

Again, I considered, that the great spreading of these dwarf-trees did not only cover a great quantity of ground to little purpose, but prevented the earth about and under them from receiving the benefit of the sun's heat, which was necessary for their health and support.

These

These thoughts made me chuse rather to lay them in espalier, than suffer them any longer to remain dwarfs, and accordingly I had frames provided for that purpose. In the laying of the trees to the frames, I was sometimes obliged to cut some of the most stubborn branches half way through, that they might be brought with more ease to spread upon the frame; and this cutting had a very good consequence, for the trees received thereby such a check in their vigorous shooting, that brought them to a right bearing state; the gardener had an opportunity of preserving proper shoots of all sorts at their due length, of maintaining proper branches of all kinds, so that there might be a continued succession of good fruit, and of preserving the trees from being too much incumbered with it; for where a tree is overpowered with fruit, it is subject to two grand inconveniences, *viz.* the fruit is always small, or it will not bear above once in three years: so that, as I have remarked in some of my former writings, there must be a succession of good branches to afford us a succession of good fruit.

In the next place, these espaliers fill very little space, and supposing the dwarfs they were made from were planted in a square at twelve feet distance, when such trees are laid into espalier, there will be spaces of ground about ten feet between every row, which admits of air and sun enough to help the trees and fruit, and may be employed to some good use: but it should be observed in the contriving such espaliers, that they rather run east and west, that the south sun may come full upon them.

Again, we have this advantage from the method I have here prescribed, that as the young grafted parts of the trees spread themselves, we may take off by degrees the older parts, and at length have our espalier quite filled from the wood of the young plants;

and when they come to decay, restore them again by the same method.

Another way of assisting decayed trees is by opening their roots, and laying about them the entrails of animals, or the animals themselves. I have done this in several of the summer months with great success, but especially in the latter end of the month of *June*, for then the trees are preparing to make new roots. It must be observed likewise, that the laying of fresh earth to the roots of trees should be done about the same time; and also we must be sure to enrich the earth among old dwarf-trees, before we plant our young stocks near them for inarching; for the old trees must certainly have impoverished the land where they have long been growing, and the stocks being of the same kind would want nourishment. But if by enriching the ground about trees we find them grow over luxuriant, so that they leave bearing: then I would prescribe a method which has been successfully practised by Mr *Thomas Fairchild*.

In *February*, he advises to lay open the roots, and cut off close by the stem some of the largest with a sharp chissel, and throw in the earth as soon as that operation is over; by which means the tree will be sufficiently hindered from an overflux of raw sap, and rendered inclinable to digest and ripen that which it already possesses, and to dispose it for framing buds for blossoms.



CHAP. XII. *Concerning the order of nature, and the use of that knowledge in the propagating and cultivating of plants; with remarks upon the disposition of gardens in general, &c.*

IF we would truly understand the nature of plants, we must not judge of them only by the outside, which will inform us of no more than that they have roots, wood, bark, pith, buds, leaves, flowers and fruit; the uses for which these several parts are designed by nature, can only be found out by examining other natural bodies, and consulting how far one is analogous to the other; and so by comparison we are brought to form such judgment as leads us to experiments, and those experiments declare how far we are right or wrong in our judgment. We should know also how far every element is concerned in the welfare of a plant; and when we are gone so far, we are next to think of the parts of a plant, and how far each of them agrees with the corresponding parts in animals, which we know the use of; then, when we have discovered how far the parts of the one and the other correspond, we are naturally brought to the discovery of their uses, *viz.* such parts as are appointed to receive the nourishment, as the roots, which do the office of the mouths in animals; such vessels or channels, as convey the juices throughout the body, as the arteries and veins in animals; and such parts as are made for the secretion of the juices, like the secretory ducts in animals, &c. but then, say some, though there is a circulation of juices in animals, that is set on foot by the motion of the heart, yet there is no such pump as the heart in plants, and therefore there can be no circulation of juices: besides, there are muscular parts in animals, but there are no such parts in plants;

nor are there nerves, nor eyes, nor ears in plants: let us then consider why plants are like animals in some things, and not in all. To this end, we must consider that animals have local motion, and plants have not; therefore all the parts that are only necessary to convey animals from place to place, would be unnecessary for plants, which are doomed by nature to stand always in the same place. Now, as animals are sometimes in cold places, and sometimes in hot, so the heart is necessary to keep their juices in motion. The muscular parts and tendons are necessary to give them strength in their motion, and their nerves to give them the sense of feeling; their eyes to guide them on their way, and their ears, as well to forewarn them of approaching danger, as to receive the word of command from their masters; but every one will certainly allow that a plant can have no occasion for these parts, for the reason given before. The motion of the juices in a plant is carried on by other powers, such as a rarefaction and condensation of the air; and understanding this particularly depends upon the knowledge of the four elements and their powers.

Now for the decorations of gardens, it will not be improper to give my reader some account of the manner of raising water, which makes so beautiful and useful a part of the design of a garden, especially in the hot seasons of the year.

The heat of the weather, which we commonly expect in *June*, has furnished me with some thoughts concerning the building of cool rooms for our recreation in summer; which, I think, can be no less agreeable in that season, than warming rooms are in the winter: for as in the colder months nothing is more generally agreeable than warm cloaths and good fires; so when the sun is in its full force, there is nothing more refreshing, or affords more pleasure to mankind, than cool breezes, whether natural or artificial; which, provided they are moderate and constant,

stant, will invigorate the spirits, and help the health of the body. Many of the curious have already endeavoured to purchase the pleasing coolness I speak of, either in grottos or pleasure-houses, placed in the middle of woods; but they have, in my opinion, fallen short of their aim, for want of taking proper measures to keep out the sun's rays, or the air, which is heated by them, either of which is equally capable of warming whatever place they enter; and were we to keep such a place, as we design for a cool room, wholly debarred from air, we should then have a greater cause of complaint. Some have yet been indiscreet enough to plant their summer-houses on the borders of great lakes and pools, believing that water, however it is stagnate, or still, will cool the air; but in this, experience shews the contrary; the pool or lake, like looking-glass, adds to the heat of the sun's rays, which shine upon it, and the water thus warmed, must necessarily emit a quantity of warm vapours, proportionable to the surface of the pond or lake; and, besides the unwholesome qualities which all vapours contain, that rise from standing waters, the air is thickened, and becomes heavy enough to damp or dull the spirits, as it wants those nourishing parts which are necessary to feed the human frame, and maintain the vital heat.

But where there is the pleasure of a river, there is also the continual advantage of a flowing and circulating air; for the purling or rolling of the stream fans the air about it more or less, as its motion is quicker or slower: so that an alcove or pleasure-house, placed near a brisk stream, must be cool and healthful in the hottest season, although it is encompassed with wood; for woods of themselves, though the common opinion is otherwise, rather promote heat than propagate cool air; for there is always a vapour rising among trees in a hot day, which thickens and deadens the air as much as the vapour which the sun exhales from

the standing pools, or such waters as are subject to stagnate. It will, however, be objected, that woods must be cool from the fanning of the leaves, which thereby cause a brisker motion of the air, than the currency of a river can do; but this, in my opinion, is easily answered. In the first place, the leaves of trees growing in a wood are never in motion, but when there is a sufficient air abroad to move them; and then it is natural to suppose, that an air so brisk in its full freedom must be more sensibly felt in open places, than it can be where it is broken and interrupted in its passage through a wood: And, I suppose, it will be allowed, that when the air is fluent or rapid enough to give us breezes or gales, we lose our desire of retiring into cooler places, as we suppose those be which are gloomy and under shade; so that either the woods are useless to us when there is a free air abroad; and when the air is of itself quiet and still, the woods are hot and unwholesome. There is indeed always the appearance of shade in close woods, which leads us to them in hot weather; but that appearance is deceitful, till the natural evening breeze has fanned its way through them, and condensed and fixed the vapour which the warmth of the sun had raised in the day.

However, the edge or border of a wood, where the air can have due liberty, may be proper enough to build such a room on as I mentioned, situated, if possible, near a river, and where the trees may interrupt the sun's rays, at that time of the day when such a room is most required; which observation, I think, is not altogether impertinent: for I have seen several pleasure houses, or as some call them, summer-houses, built in such places where the sun lies upon them at those times when they would be the most useful, thereby rendring them disagreeable to their design. Things of this nature too frequently discourage our nobility from proceeding in their undertakings,

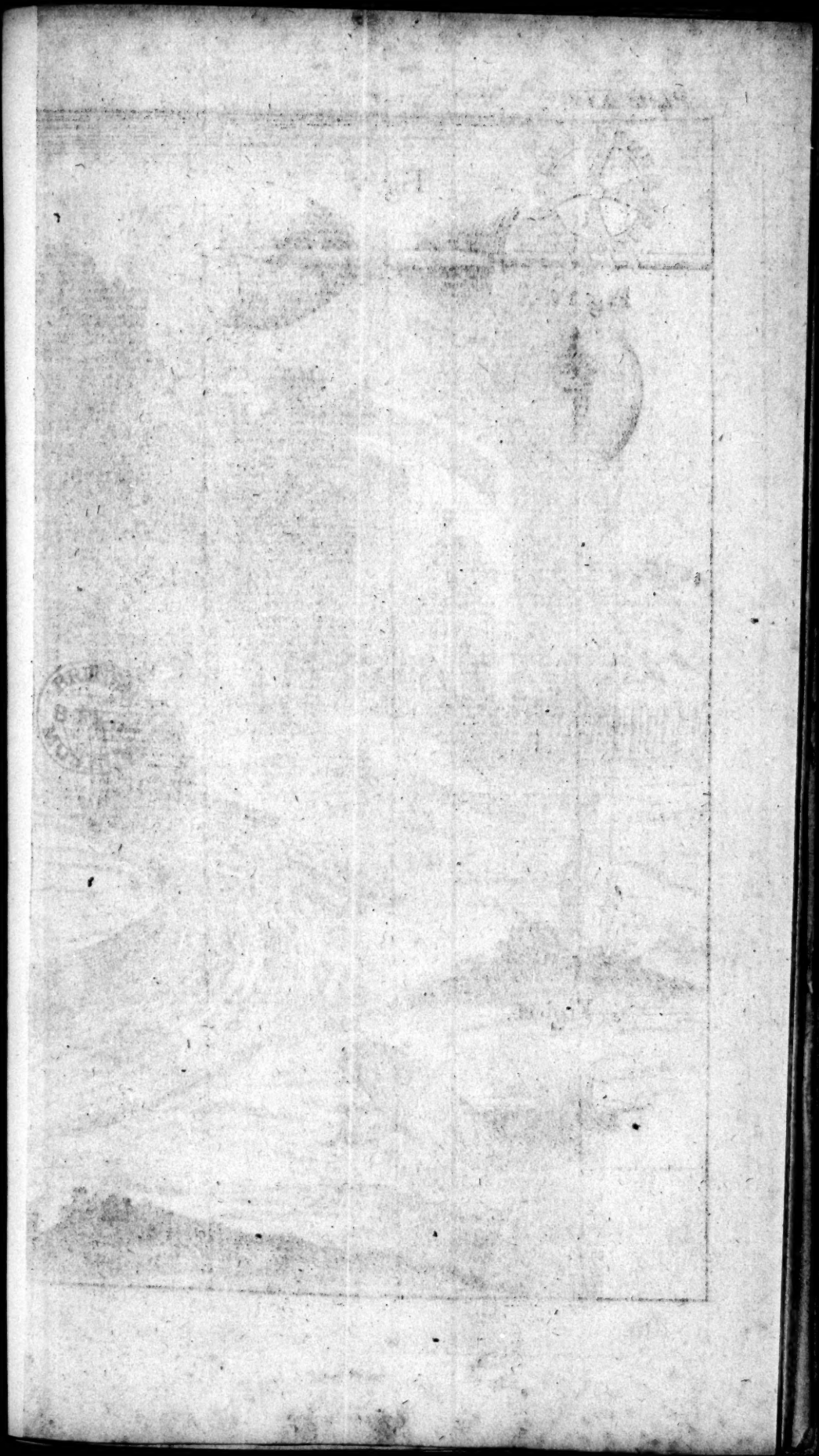


Plate XIV.

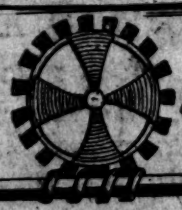
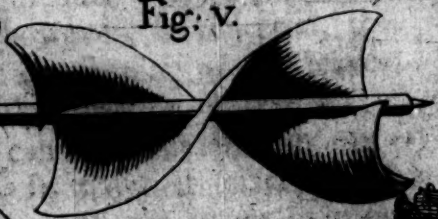
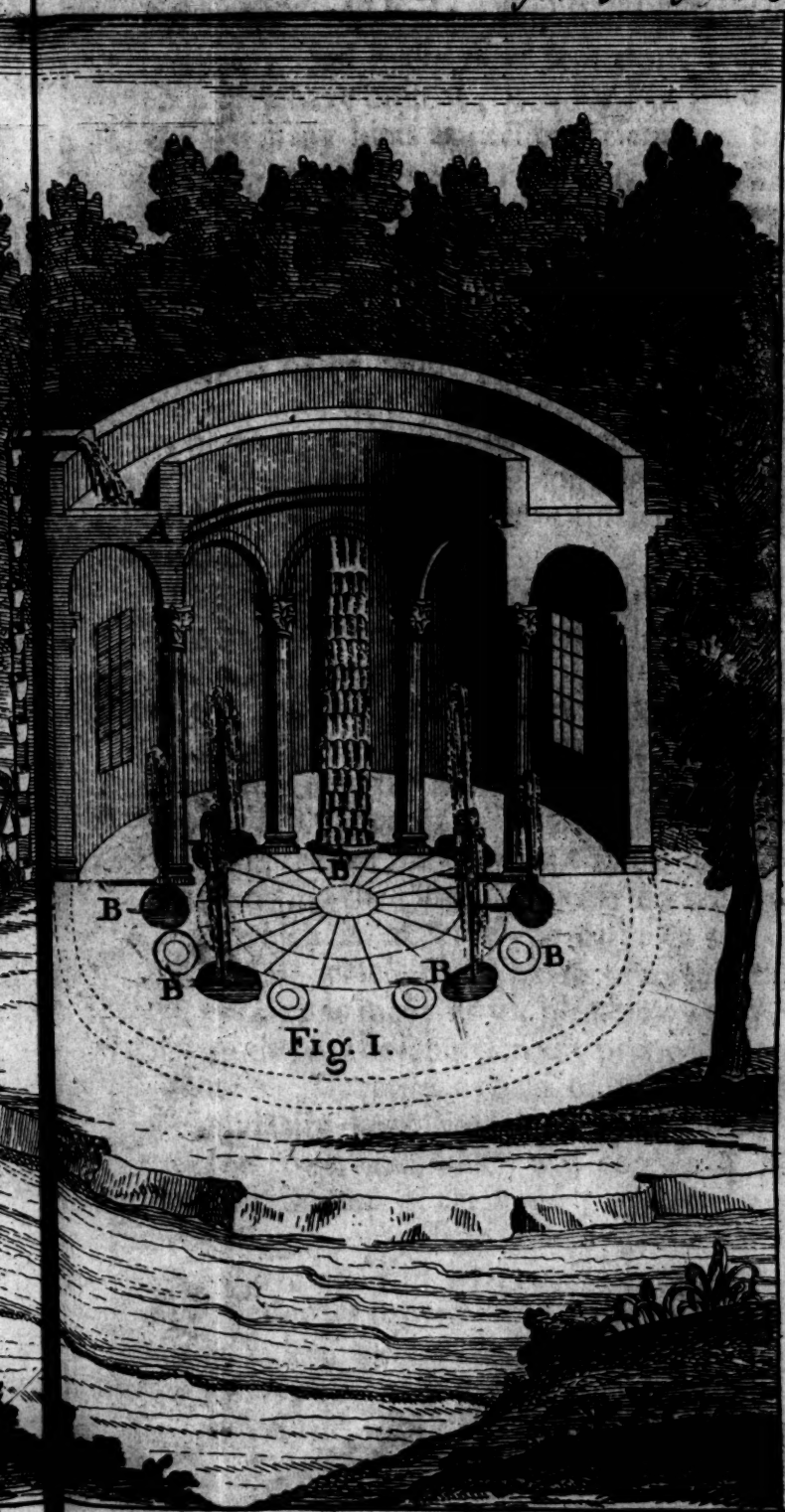


Fig IV.



Fig. V.







derrakings, and make them sometimes regret the expence they have been at; it is for that reason I would drop as many hints as possible relating to this sort of building, that my readers may be apprised of every thing necessary to be thought of in such a work.

As for the building itself, the walls ought to be very thick, and the windows so disposed, that they may, as occasion offers, either shut out the heat or warm air, or be rendered capable of admitting the light and cool air: we may likewise observe, that in lieu of glass, we should either use sashes of canvas or oiled paper, which will still contribute to the coolness of the room, as we find by experience in the hotter countries.

The house, *Plate XIV. Fig. I.* should, in my opinion, be either round or polygonal, and not square; because the more sides such a building has, the less will the sun, if it shines upon it, be capable of heating the walls. The section I have given in *Fig. I.* will sufficiently shew the nature of the design; but I shall leave the rest to our able architects, only observing that the pillars are not for ornament alone, but for the better supporting the cistern of water on the top marked A, A, which is to serve the cascades and fountains B, B, B, B, B, which must be so ordered, that either one, two, or as many as we please may play, that the air may thereby be fanned in any proportion we desire.

Ibid. Fig. II. shews a chain of buckets, which may be continually kept working, by means of a wheel cross the river, and which will constantly supply the cistern on the top of the house; and the water being once brought together in a body, and deposited in a basin above us, will by proper pipes give us the jets and cascades we desire.

It is indeed pretty well known, that if we have water above us, its weight will force its way through pipes, and rise with a certain strength agreeable to the height of the body of water; but as it is my business

to instruct, I must now and then be obliged to mention some things which are seemingly common; and I think myself the more obliged to do it, because I observe, that whatever is common, though never so useful, is the least regarded by the people.

Thus the great wheel of a mill is commonly known to be turned by the current of a stream, as those wheels are, which give the movement to the water-works at *London-bridge*. Hence I doubt not, but the common people conclude, that because they can be turned by a stream of water at one time, they may by the same means be kept continually in motion; but if we examine this case a little more attentively, we shall find that these wheels stand still, and are endangered in great floods, so that we cannot always have the assistance we expect from them. The ingenious Mr *Harding*, in order to remedy these defects, has invented a curious wheel, which moves as well if it is entirely under water, as the others do in the common mills above the water; and his wheel carries this advantage along with it, that without the expence and trouble of shifting it higher or lower, as the waters rise or fall, or penning or damming up the water, it will constantly keep in motion, either backwards or forwards, as the sets of the stream or tides vary.

This wheel is fanned somewhat like the sails of a wind-mill, or rather like the flying wheel of a jack, which is turned by the smoke of a chimney; the model I took my design from, was made of two slips of tin, about two inches broad, which were respectively placed in a worm-like manner, upon an axle-tree, so as to preserve an equal distance from one another in every part: this wheel, pointing to the course of a river, will continually keep in motion, whether it lies deep or shallow in the waters, or as we observed before, whether the tide sets one way or the other.

The first design of this wheel was to work a mill in a barge, which might be either fixed in any part of a river,

river, or removed from place to place, as occasion offered, and so to avoid the unnecessary expence of dams, which hinder navigation; it likewise appears to me to be useful in any breach made by a too great overflux of waters; for by the same force of water which turns it upon the coming in of tides, it would return back a great part, by means of an engine rightly framed to its motions; and when the back waters had the power on their side, it would not only move by their direction, but by means of the engine it works, carry over any bank an extraordinary quantity of water, besides what would return by the breach upon the fall of the tides. The axle-tree is of one continued piece, reaching some distance beyond the wheel, and acting as a worm or screw works upon a counter-wheel.

Ibid. Fig. III. represents this wheel length-ways, Fig. IV. the front view, and Fig. V. a different view of its fans length-ways, with the manner how the screw on the axle-tree turns the counter-wheel.

An account of a new invention for raising of water, and how far an engine of this kind may produce a continued motion, even though the foundation be a still water, or a fund of water without any current.

Among other things, which make part of my studies, I have bent my mind sometimes to contrive ways for raising water, and meliorating it.

One of the designs, which will afford my reader some speculation, I shall give in these papers, that it may be brought to practice, or at least cultivate such notions among the curious, as may help their studies.

But before I describe my engine, it will be necessary to shew my reader on what occasion it may be employed, and in what case it may be most useful, which I shall explain by describing the situation of the ground, which first led me to the thought of the invention.

Near

Near one of the most magnificent palaces in *England*, is a very large pool of standing water, which lies so much below the house, that it is with great cost and labour that the house is benefited by it; nor is it more useful to the fine gardens that encompass it, than barely to maintain fish, and serve for ornament. The lands which are adjoining to this pool, are in some places higher than the house, and in others much lower than the pool; both which contribute to bring about my design: for upon the higher ground may be made such a reservoir as will serve the house, and the lands which lie below the pool are of service to my purpose, for raising the water from the pool to the reservoir to be made upon the high grounds; from whence it might, for ornament sake, be let fall in cascades into the first pool, or great fund of water, and so kept in motion for a long time. As for example,

Plate XV. Fig. I. A is the great pool of water, from whence a pipe must be laid to turn an overshot-wheel in a pond below it, marked B. The motion of this overshot-wheel turns a chain of buckets, which dip in the pond B, and are guided up and down by two ropes, which are placed at such distances from one another, as to keep the chain tight; so that the full buckets empty themselves about fourteen or sixteen feet above the surface of the water in B; and the water which is thus continually discharged from the buckets into a trough, runs into an upper receiver marked C, where there may be about ten feet gained in height above the pool A. When the reservoir C is full, we may let the water run from thence to turn an overshot-wheel in the reservoir D, which must be so much lower than C, as to cause a fall to turn the overshot-wheel in D; and this overshot-wheel will turn another chain of buckets like the former, so as to carry the water high enough to run into the reservoir E,

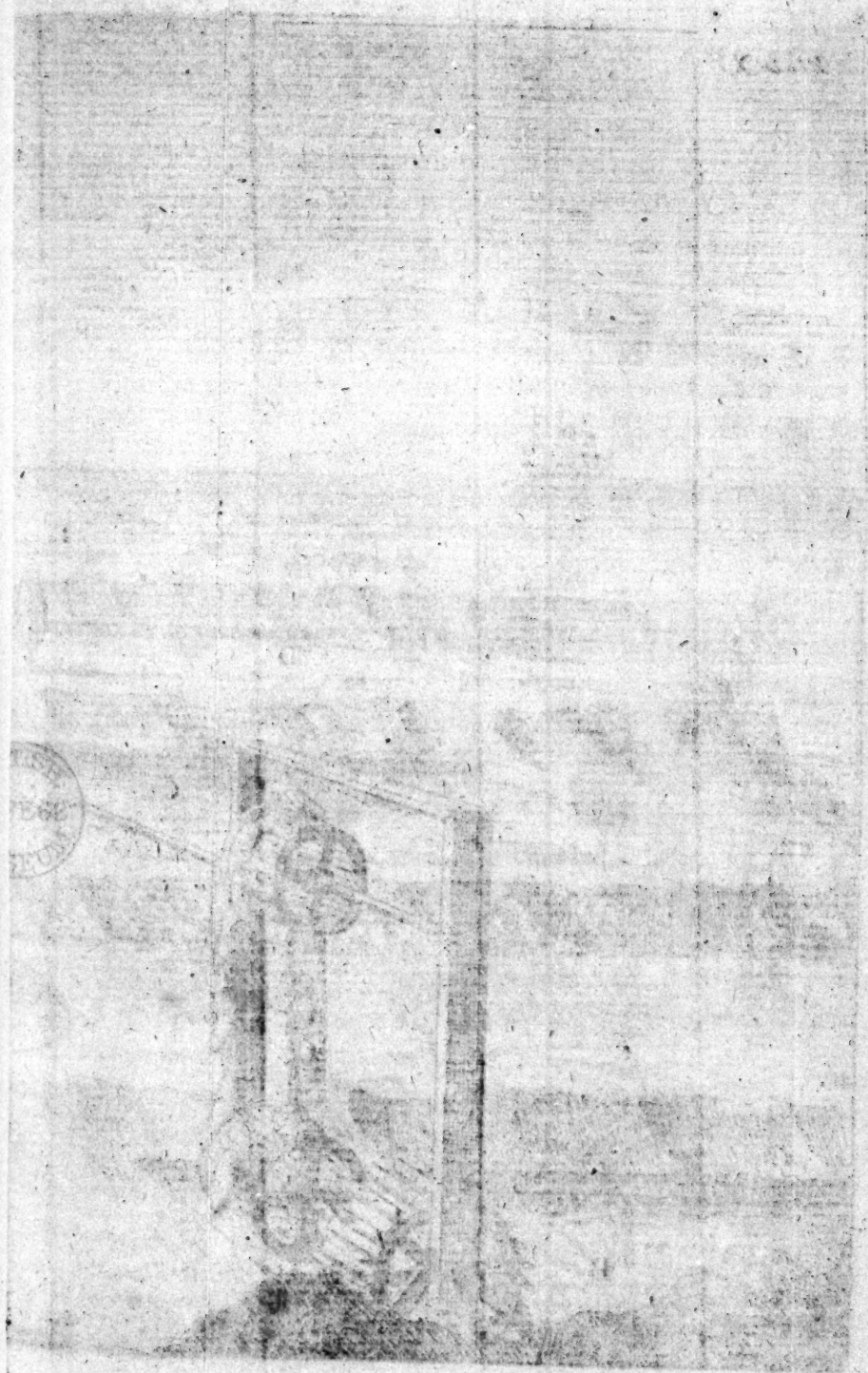
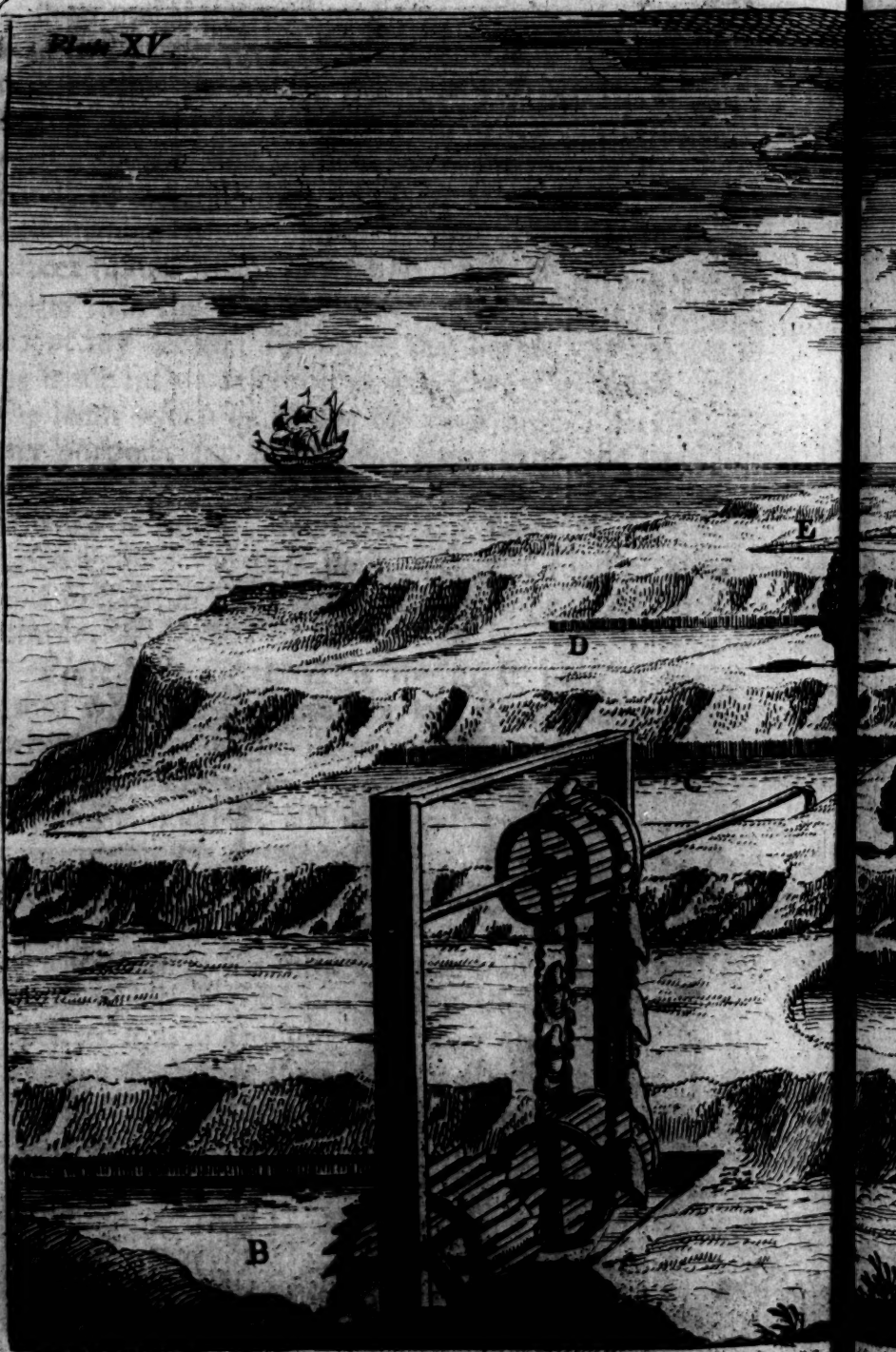


Plate XV.



facing Page 426.



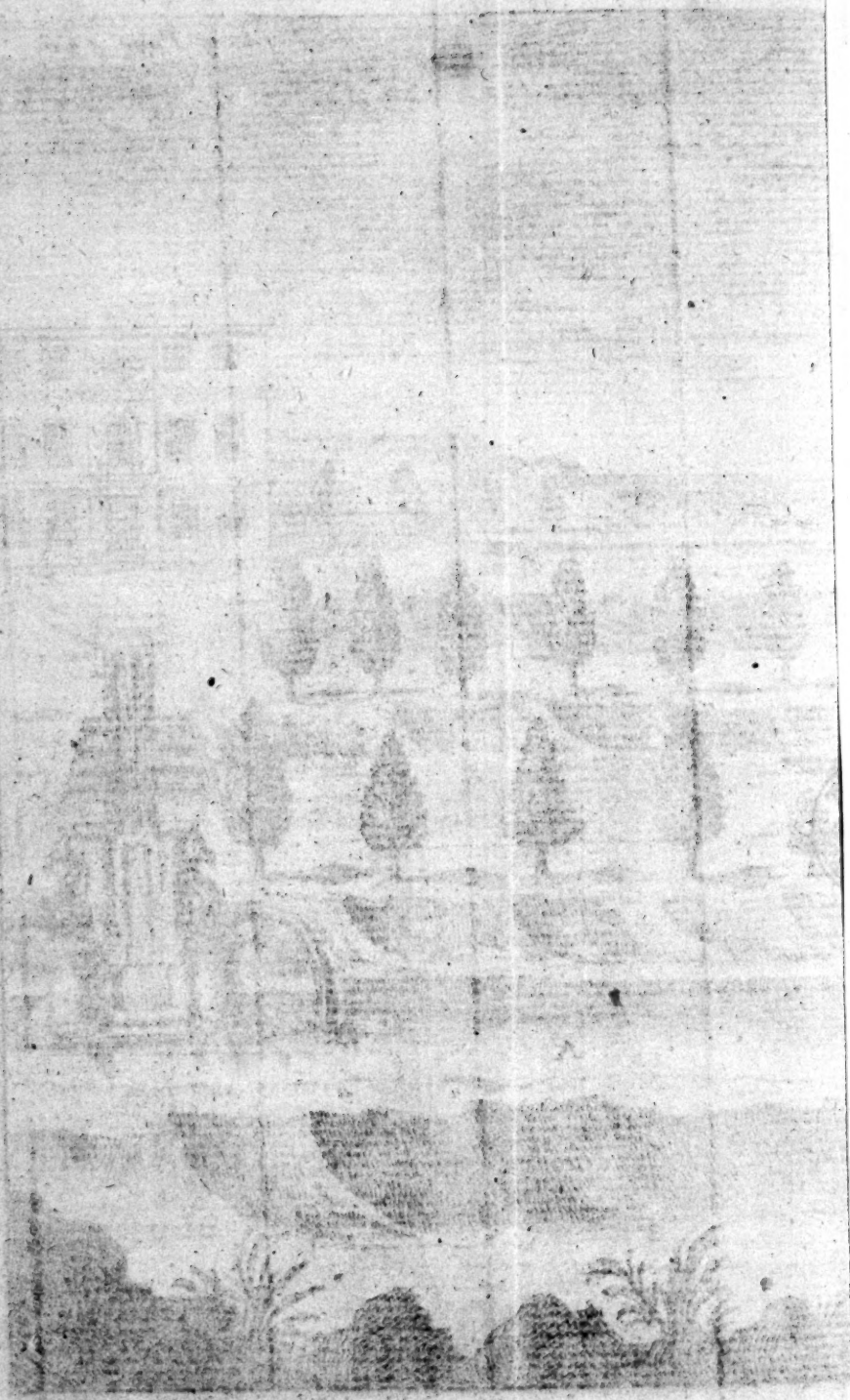


Plate XVI. Fig. I. is the ground-plat of a wall, built semicircular in sweeps, each sweep measuring eight feet over A, A, A; at the back of this are two ovens B, B, which are each four feet long, and three feet broad, before they open into the flues C, C, C; the flues at the back of the wall are two feet over, and as much in height: when they come to turn at the corners they are reduced to a foot wide, and rise gently to convey the draught of smoke and heat into the flue C, which runs in the front of the niches, to be carried up the chimney D. On the top of this front flue are set the pannels of glass, which slope gently towards the top of the wall, where they meet coping; in the middle of every nich a vine should be planted, and so ordered, as I shall direct hereafter.

Ibid. Fig. II. is the upright of the same wall, made to front the south sun, which method must be observed in all the other walls built for this purpose.

Ibid. Fig. III. is the ground-plat of a wall built in niches, in the figure of half an hexagon, each nich eight feet over A, A, A. At the back of the first nich is an oven or fire-place three or four feet square, marked B, opening into a flue B, of two feet high, and a foot and half over, reaching about two feet and a half high in the wall: at the end of this flue, where it enters the chimney, about four feet high in the wall, there is another oven or fire-place as large as the former, marked C, which opens into a flue C, that is of the same dimensions with the flue B, and runs over or above, and parallel with it.

This front is glazed and planted like the former; the niches of both are very proper for preserving cabbage-lettuce and young fallads in the winter; when the fires begin to work, we may likewise put in kidney-beans, or some dwarf-pease; but I shall say more of these things in another place.

The

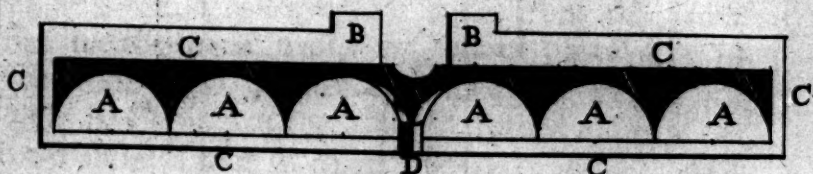


Fig. II.

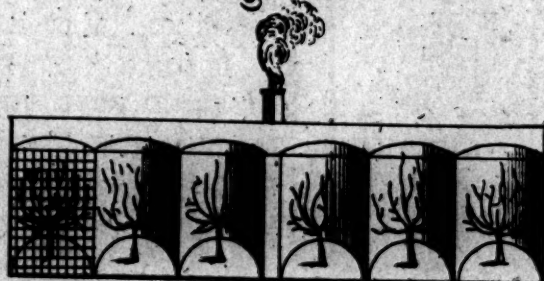


Fig. III.

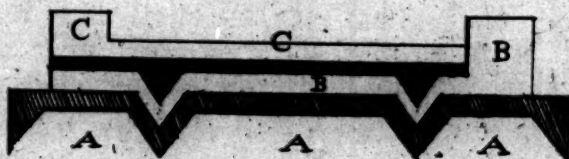
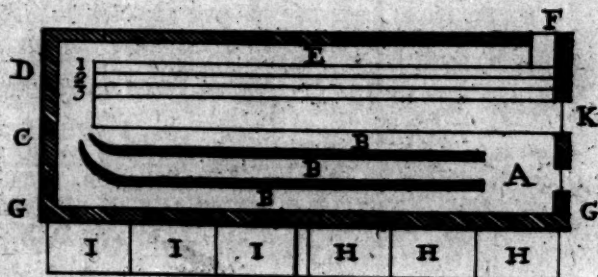
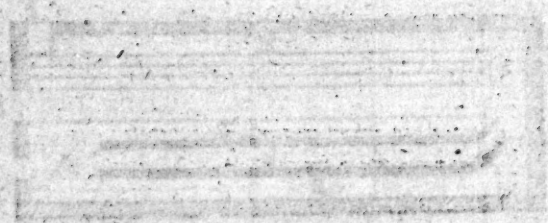
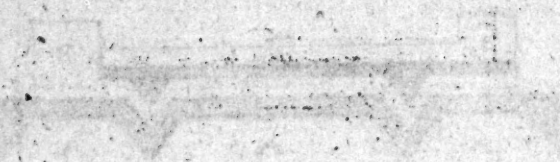
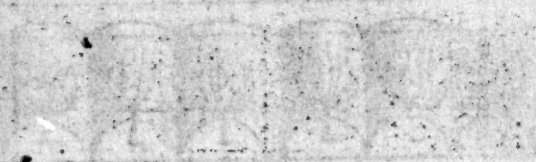
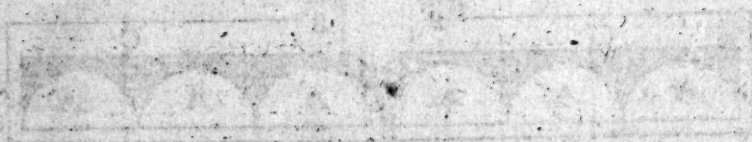


Fig. IV.





The next stove or conservatory I shall take notice of, is that built by Mr *Fairchild*, which is contrived for several good uses; and among others, I am of opinion, it will bring the ananas or pine-apple to bear fruit; it is ten or twelve feet wide from the front glasses to the back wall, and about forty feet in length; the front frames to which the glasses are hinged, lie sloping to the back in such a manner, as to drop about a foot from an upright, and the roof or cieling is higher in the front about a foot than it is at the back wall; the fire-place or oven is about three feet square, marked A, *Ibid. Fig. IV.* About a foot high this oven opens into three flues marked B, B, B, running parallel one to another into C, the whole length of the house. At C they are all resolved into one flue, which in the breadth of the house to D rises about three feet higher, and then runs through a flue E to the chimney F, which gives a draught to the whole, and a due degree of heat every where.

The flue E is covered with square tiles, and is the uppermost of four steps for the standing of pots: between the steps and the front flues B, B, B, is a walk about three feet wide, laid with sand, which preserves an heat when the fire is out.

The three flues marked B, B, B, are covered with square tiles, so disposed, that a bed of sand of a foot thick may lie upon them, into which some pots with the most tender plants are to be set; and such a sand heat is accounted the most constant of any other, and may be regulated to any degree of heat, by adding or taking away of sand.

Over the fire-place A are three pipes of earth, about three inches each in the bore, which being heated, let into the conservatory an air duly warm, and prevent damps and a stagnation of air in the house; and near the same fire-place is placed an earthen pipe, which conveys hot air at discretion into a glass-frame marked H, H, H, by G, which is the front wall of the conservatory

servatory I have been describing: this front wall is about two feet high, upon which the great glass-frames of the conservatory are rested. This wall marked G, G, is heated by the fire in the flues, and is contrived so as to make the back of the frames marked H, H, communicate a gentle warmth to them.

Against this wall from G to G are to be planted some of the common *May*-cherries, which are flow growers; and though the wall may not be in the clear above twenty inches high from the surface of the bed, yet by leading the shoots of such trees horizontally, the trees will have full room enough to grow and bear fruit.

Upon the bed, or in the frame marked H, H, H, and I, I, I, may be planted tulips, narcissus, jonquils, hyacinths; and towards the front, which is the shallowest part, crocuses and winter aconites, to come in *December*. The bed H, H, &c. will bring its flowers perhaps a month sooner than that marked I, I, I, proportionable to the distance from the fire-place. At the end of the bed marked I, I, &c. is an earthen pipe to let warm air out of the conservatory into the little frame, in case of an extraordinary frost. The figures, 1, 2, 3, are so many steps covered with square tiles without flues under them, for the pots of the less tender exotic plants; such as aloes, and others, which come from places from twenty-five to thirty-five degrees latitude: but the bed of sand B, B, B, will be hot enough for plants from twenty-five degrees latitude to the line. The door-way is at K, which opens from another house into the conservatory; so that the air which enters it upon opening the door is never over cool, but is softened by the warmth of the fire-place. An house of this kind may be divided by a partition of glass; for any thing less transparent would occasion too great a shade in both divisions, at the very seasons when the sun's presence is most necessary.

The

The use of the partition is, that we may give air to the plants in one division, when we design to give none to the other; for the plants in one should be only such as come from places of northern latitude, and the others of south latitude, which always have different seasons of growth, as their natural spring happens either on this or the other side of the line; and we ought to humour our plants, and encourage their shooting, only at such times as it is natural for them to grow.

In some stoves or conservatories, the fire-place is a kind of oven covered with plates of cast-iron, so that the space of the oven is about ten feet in length, and five in breadth, and the flue leading from it runs parallel with the back of the house, and then taking a turn runs along the front, just within the glasses, ending in a chimney that passes through the end-wall: this flue is about fourteen inches wide, and about eighteen in depth, and is covered with iron-plates of about two feet in length: over the whole is laid a covering of sand of three or four inches thick, and upon that a pavement of square tiles. A stove or conservatory thus prepared for giving heat, may be about fifty feet in length, ten feet wide, and ten feet high in the back wall from the floor, and should always have a door or two opening into some other house or room, to let in regulated or corrected air, when the heat is too intense; for air may be too much rarefied or refined by heat for a plant to live in, as it may be for an animal to live in. For want of this caution, I have known plants to change their healthful verdure for a pale, sickly colour, which has ended in death; and I am persuaded, many a man has grown sickly for want of a due freedom of breathing a well regulated air, which I am satisfied may be rendered more or less agreeable to our constitutions by art.

The

The fires to be used in these stoves or furnaces are either wood, coal, turf or peat.

The first is sudden and unconstant, affording a much hotter smoke than either of the others, and therefore is the best for warming the walls, for forwarding of grapes and other fruits, where the flues are of great length.

The coal yields a more lasting heat, affords a smoke of a moderate warmth, and may do well enough to warm flues of a tolerable length: but turf or peat, such as they burn in *Holland*, gives us a constant equal heat, and yields no perceptible smoke; it warms the air in the flues, and never disturbs plants; and where this is burnt, there must always be a much larger oven to gather a fund of heat than when we burn wood or coal; where such ovens or fire-places are large, and covered with iron, we may cover their pavement or floors with sea-sand, four, five or six inches thick, to regulate the heat, and give an agreeable dew to the plants, in imitation of what they would meet with abroad.

I would not have my readers mistake this dew, for a damp which often rises in green-houses; that damp proceeds from a moist stagnating air. The dew I speak of is a gentle circulating air, filled with vegetative salts, such as nourish plants; but the damp destroys them.

I have sometimes thought, that if it was possible to have a room built adjoining to a glass-house, and to have its windows face the south, that in such a place one might cultivate the most tender plants without great expence; for the continued fire in the glass-house might be contrived to keep the air in the room adjoining of a constant warmth, equally the same day and night, and might also be of excellent use in some chemical preparations; for the glass-house fire burns for many years without intermission. I offer this

this as a hint worth improving by the curious, who can have opportunities of building a laboratory, or a conservatory for raising of plants, to have a communication with the furnace of a glass-house. I suppose by such means, as well as by the stoves I have described, we might well enough ripen the ananas, and raise plants of cucumbers and melons at any time in the winter; and the bananas, guavas, and other *West-Indian* fruit, as well as the mango of the *East-Indies*, would, doubtless, grow very well in such warm places.

CHAP. XIV. *An account of the ananas, or West-Indian pine-apple, as it now flourishes in Sir Matthew Decker's gardens at Richmond, under the care and management of Mr Henry Telende, and others, &c. with some account of the construction and uses of the thermometer, barometer, and hygrometer.*

THE plant I am going to treat of is called the pine-apple, from the resemblance the shape of its fruit bears to the cones or apples of the pine-tree; and in nothing else but the shape of the fruit is the pine-tree and the ananas alike: the cones or apples of the pine-tree race, such as firs, cedars, and even the cypress, appear knotted or knobbed, like the fruit of the mulberry, but they are much larger, as are also the fruit of the ananas. The cones I speak of are of a woody substance, whether on the pines, pineasters, firs, cedars or cypress; but the fruit of the ananas is soft, tender and delicate, and excels all the fruits in the world in flavour and richness of taste. The cones of pines and firs, we must observe, are of different shapes; some pointed at the top of a conic figure, as the apples or cones of the *Scots-fir*; others of equal

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oigness at top and bottom, like the cones of the cedar of *Lebanon*; and as these cones vary in their shape, so we find the fruit of the ananas of different figures. I find some of the ananas with fruit almost pointed on the top, and some are broad there; in a word, the forms of the ananas fruit are as various as those of the apples or cones of the fir or pine-tribes; which I have often observed in those pine-apples that have been brought us as rarities from the *West-Indies*.

But as the pines and firs make large trees, so on the other hand our pine-apple is an herbaceous plant, perennial, and bearing leaves in the manner and form of an aloe; they are indeed less juicy or succulent than those of the aloe succotrina, but for the most part sawed on the edges like it: some kinds of our pine-apples have leaves above two feet long, which grow more upright, others curl their leaves backwards; and again, others are short and slender.

But I proceed to give an account of the method now practised at Sir *Matthew Decker's* at *Richmond*, for the production of this excellent fruit, which Mr *Henry Telende*, his gardener, has rendered so easy and intelligible, that I hope to see the ananas flourish for the future in many of our *English* gardens, to the honour of the artist, and the satisfaction and pleasure of those who can afford to eat them.

Mr *Telende's* account of the progress of the plant, from the first slipping or planting the crown of the fruit to the ripening fruit upon those suckers or plants, is as follows.

In *July* and *August* we are to take off the suckers, or young shoots which sprout from about the root of the large plants; and it is then necessary to prune off the wounded parts at the root-end of the suckers, till we make them smooth, and can perceive little spots, which shew us the rudiments of the roots. These young plants so prepared, must be planted singly in such pots as are commonly used for auriculas, which
are





are about six inches in diameter on the top, and somewhat more than four inches wide at the bottom; in the planting these, as well as the crowns, we must press the earth very close and hard about them.

The earth most proper for them, as I am informed, must be very finely sifted, and rather light than stiff, such as a sandy loam, of a black sort; but if it is a mixt soil, it should be three or four years old to be well incorporated.

This time of planting, and the degree of heat which Mr *Telende* gives them, makes them strike root in a short time; and from what I can learn, some of the same plants will prepare for fruit the spring following, especially the crowns of the fruit, as in *Plate XVII.* at A. The time of their blossoming at *Richmond*, is commonly about *April*, when their fruit appears about the bigness of a tennis-ball; but this depends upon the degree of heat: the flowers then shew themselves single on each knot or knob of the fruit, about ten parts in twelve of an inch in length, of a blue colour; but it is observable, that those which produce fruit of the red kind, bear flowers of a deeper blue than those of the yellow sort, which kind the *Plate* represents. Here it is observable, that from the first appearance of the fruit among the leaves, to the time of its bringing the flowers, there is about three weeks; and then the blossoms begin to open on the lower ring of knots or knobs of the young fruit, and gradually flower to the top of it in about eight days time; but this time of flowering is in proportion to the bigness of the fruit. As it is longer or shorter, its number of circles or knots will be more or less; for as the fruit is longer, the circles of knobs are in a greater number; and as all flowers have a certain length of time to blossom before they fade, so, consequently, those fruits which have the largest share of circles, must hold longer in blossom than the small ones.

Mr *Telende* reckons about five months from the first appearance of the fruit to the time of its full ripening; and observes, that when it tends to maturity, it first changes from a green to a grey or whitish colour, and in about nine days more it is fit to eat, having then gained its full colour and flavour: but I suppose it will not ripen in winter so quickly from the blossom, as it does with him, who has for a year or two ripened it in the hottest months. He tells me, that to judge rightly of the ripeness of the fruit, he first examines whether it is of the yellow or the red sort, and whether it is of a full colour; he also observes, that when either sort changes towards brown, it is past its excellence, and is over ripe; but if it is in full perfection, we may press in the knots or knobs of the fruit gently with the finger and thumb, and they will return again: the yellow or red sort must be bright in colour to be good (a).

When

(a) This plant is propagated by planting the crowns, which grow on the fruit, or the suckers which are produced from the plants, or under the fruit. The suckers and crowns must be laid to dry in a warm place, for four or five days or more (according to the moisture of the part which adhered to the old plant or fruit) for if they are immediately planted, they will rot. The certain rule of judging if they are fit to plant is by observing if the bottom is healed over and become hard, for if the suckers are drawn off carefully from the old plants they will have an hard skin over the lower part, so need not lie so long as those which by accident may have been broken: but whenever a crown is taken from the fruit, or the suckers from old plants, they should be immediately divested of their bottom leaves, so high as to allow depth for their planting, so that they may be thoroughly dry and healed in every part, lest when they receive heat and moisture they should perish, which often happens when this method is not pursued.

As to the earth in which the ananas is planted, if you have a rich good kitchen-garden mould not too heavy, so as to detain the moisture too long, nor over light and sandy, it will be very proper for them without any mixture: but where

this

When the fruit is ripe, the next thing to be considered is, how to bring it upon the table, and manage it there; for this fruit is of such a nature, that if

this is wanting, you should procure some fresh earth from a good pasture, which should be mixed with about a third of rotten neats-dung, or the dung of an old melon, or cucumber-bed, which is well consumed: these should be mixed eight or six months at least before they are used, and should be often turned, that their parts may be the better united, as also the clods well broken. This earth should not be screened very fine; for if you only clear it of the great stones, it will be better for the plants than when it is made too fine. There should be no sand mixed with the earth unless it be extremely stiff, and even in that case not more than a sixth part of sand.

In the summer-season, when the weather is warm, these plants must be frequently watered, but you should not give them large quantities at a time; you must also be careful that the moisture be not detained in the pots by the holes being stopped, for that will soon destroy the plants. If the season is warm they should be watered every other day, but in a cool season twice a week will be sufficient; and during the summer-season, you should once a week water them gently all over their leaves, which will wash the filth from off them, and thereby greatly promote the growth of the plants. This plant will not require to be new potted oftener than twice in a season; the first time should be about the end of *April*, when the suckers and crowns of the former year's fruit (which remained all the winter in those pots in which they were first planted) should be shifted into larger pots: but you must be very careful not to overpot them; nothing being more prejudicial to these plants. The second time of shifting them is towards the latter end of *August* or beginning of *September*, when you should shift those plants which are of a proper size for fruiting the following spring. At each of these times of shifting the plants the bark-bed should be stirred up and some new bark added, to raise the bed up to the height it was at first made, and when the pots are again plunged into the bark-bed the plants should be watered gently all over the leaves to wash off the filth and to settle the earth to the roots of the plants; this being done, they may remain in the tan till the beginning of *November*, or sometimes later if the sea-

it is not skilfully prepared after it is gathered, it loses half its beauties.

It is commonly cut from the plant with a long stalk, so that it may be set upright in a tube of glass, to crown

son is mild: for in that case they will require no fire before that time. During the winter-season these plants will not require to be watered oftener than every third or fourth day, according as you find the earth in the pots to dry; nor should you give them too much water each time, for it is better to give them a little often than to over-water them, especially at that season.

There is not any thing can happen to these plants of a more dangerous nature than to have them attacked by small white insects, which appear at first like a white mildew, but soon after have the appearance of lice: these attack both root and leaves at the same time, and if they are not soon destroyed, will spread over a whole stove in a short time. The safest method of destroying these insects, will be to take the plants out of the pots and clear the earth from the roots; then prepare a large tub, filled with water, in which there has been a strong infusion of tobacco-stalks; into this tub you should put the plants, placing some sticks cross the tub to keep the plants immersed in the water. In this water they should remain twenty-four hours; then take them out, and with a sponge wash off all the insects from the leaves and roots, and then cut off all the small fibres of the roots, and dip the plants into a tub of fair water, washing them therein, which is the most effectual way to clear them of these insects. Then you should put them in fresh earth, and having stirred up the bark-bed, and added some new tan to give a fresh heat to the bed, the pots should be plunged again, observing to water them all over the leaves as was before directed; and this should be repeated frequently during the summer-season.

It was formerly the practice of most people who cultivated this fruit in *Europe*, to build dry stoves in which they kept their plants in winter, placing the pots on scaffolds, and in the summer to keep them in hot-beds of tanners bark under frames, but this is found by late experience a bad method, for the glasses lying so near over the plants, there is not a sufficient quantity of air in the bed to nourish the fruit and give it that vinous flavour which good fruit always abounds with, and

crown the top of a pyramid of fruit; and whoever once tastes of it, will undoubtedly allow, that it deserves a place above all other fruits, as well for its beautiful appearance, as for its delicious flavour, which partakes of every thing that can be found agreeable in all kinds of fruit.

To prepare it for eating, hold the fruit B *Ibid.* in one hand, while with the other you twist off the crown of leaves at the top, which should be presently returned to the gardener, to be cleared of the pulp which adheres to it, and planted for increase. When the crown of leaves is off, begin at the top to pare off the rind of the fruit; which must be so done, that none of the outside husks remain, which would be very troublesome in eating. When this is done, cut it in slices cross-ways, to be laid singly upon a plate; for if they are laid upon one another, it is hard to separate them, the fruit being of a gummy nature, sticking like honey: thus it is ready for eating without any addition of sugar, wine, &c. to help its flavour.

The next thing to be mentioned, is Mr *Telende's* method of making the hot-bed of tanner's bark, for the production and ripening this fruit in the more gentle seasons of the year, and this I shall set down exactly agreeable to his present practice, which may serve as the standard and pattern to all the rest.

First, his frame is made of whole deal, closely jointed, after the manner of an hot-bed frame, but its proportion is different.

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and when these glasses are closely shut down in the night, the vapours which arise from the fermentation of the tan and the perspiration of the plants are closely pent in, and being condensed against the glasses fall in water on the plants. Therefore to remedy this inconvenience, it is now the practice to erect low stoves with pits therein for the hot-bed; these are built different ways, according to the fancy of the contriver.

Miller.

The length of this frame is eleven feet, divided equally into four lights or pannels of clear glass, in panes of a moderate size; the wideness of the frame is seven feet and a half; the back is three feet high, and the front about ten inches.

The place or pit for the hot-bed is somewhat more than five feet deep in the ground, made proportionable to the length and breadth of the frame; the sides of this pit are lined with brick-work, and the bottom covered with pebble or rubble-stones. This being prepared, he provides, about the middle of *February*, as much hot dung or horse-litter for the foundation of this bed as will raise it from the pebbles about a foot high, and then lays on the tanner's bark as equally as possible, till the case of brick-work is filled, beating down the tan gently with a prong, or pressing it down easily with a board; for if it was to be trod, or beat too hard, the tan would not heat in three months. A bed of this kind, he tells me, will take up three hundred bushels of tan, or tanner's bark; and if it be well made, will heat in about fifteen days, provided the frame and glasses are set over it; but if it remains uncovered, it will not come to its heat in less than six weeks time.

When the bed breathes a right heat, which we are to judge of by a thermometer, (as I shall mention by and by) we bring the plants from the stove to it, either to have their pots quite plunged into the bark or tan, or, if upon opening the holes for them, we find the bark too hot, to set them in only half way, laying a few pebbles under the bottom of each pot, that the water may pass freely through them. We are also to take care that we do not remove the plants from the stove to the bed, in frost or snow, for fear of injuring them: and we must as carefully examine our bed from time to time, whether the bark grows mouldy, musty or dry, which it will often do in the summer;

summer; we must, in such a case, water it, to recover its heat.

The ananas is no great lover of water; a very moderate proportion only must be given at the time it does not grow or shoot; but frequent and gentle refreshings are necessary when the plant flourishes, and especially during the time of the growth of the fruit.

A bed of tanner's bark, prepared and managed according to these directions, will maintain a constant degree of heat, sufficient to give these plants the utmost vigour they require, from about the end of *February* to the end of *October* following; and then the plants must be again removed into the stove or conservatory.

During the time the plants continue in this bed, we are constantly to keep them covered with the glasses, unless at the time of watering, or such necessary works as are unavoidable. In the excessive heats, indeed, the glasses are tilted up at the back of the frame; and in cool evenings, the bed must be carefully covered with substantial mattresses of straw. A bed of this kind sinks about a foot, from the time of making it to the end of summer; which happens to be very convenient in this affair, or else the plants would grow too tall for the frame, before the time of housing them.

The water (Mr *Telende* observes) which is necessary to refresh or water these plants, should be kept in a place where the heat is equal to that of the hot-bed; or when they are in the stove, he would have the water set in the same place, that they may not feel the least check by receiving water, which is colder than the air they breathe.

Thus we are, by the foregoing remarks, instructed in the method of preserving and forwarding the pine-apples, from the middle of *February* to the end of *October*; and at the same time we may judge how useful such a method of culture would be to all such plants,

plants as are natives of climates equally hot with *Jamaica*, the *Caribbee-Islands*, and two or three degrees more south. The guava, which comes from thence, a fruit of a delicate flavour, will ripen here as well as the pine-apple; and there is no doubt, in reason, but the bananas, plantains, and even the mango, would prosper as well with us; since the ingenious person, who has brought the pine-apples to the same perfection in *England* that they attain to in their own country, has pointed to us by the thermometer, the just degree of heat he constantly gave them; which heat is then surely agreeable to that of the country they came from, for otherwise they could not appear under his care with so good an aspect as they now do, even as large, as fair, and as well tasted, as those in the *West-Indies*.

The stove I mentioned in these papers, with the iron-plates over the flues, is of that sort he uses; but for the greater warmth, his stove is covered thick with thatch on the roof, and the glasses are well guarded with shutters; and that the fire under it may be constant, he burns only such turf as is commonly used in *Holland*, agreeable to Mr *Le Cour*'s method, whose great skill first brought these plants to be admired in the *European* gardens.

But as I observed before, that the degree of heat necessary for this end, was pointed out to us by the thermometer; so the same degree of heat must be as well observed in the hot-bed as in the stove or conservatory; we find by the consequence, that it agrees with that of the country where the pine-apples grow naturally: and by the same thermometer we find, that the heat of the stoves and hot-beds may be raised much higher, even to be equal to the heat under the line or equator; so that there is not any plant upon earth which may not be made to grow in *Britain* by such helps. The spice-trees or plants of the hottest climates, whether the nutmeg tree, the cinnamon-tree,
the

the several sorts of clove-trees, the pepper or the ginger, would certainly prosper in such stoves, if we gave them their exact share of heat.

The thermometer used by Mr *Telande*, has a tube about twenty-four inches long, the diameter whereof is about one eighth part of an inch; by this he has remarked, that when the spirit rises to fifteen inches, the air is *cold* for his plants; at sixteen inches and a half, *temperate*; at eighteen inches, *warm air*, which is his standard for pine-apple heat; at twenty inches he marks *hot air*; and at one and twenty inches and a half, *sultry*; but these degrees are differently marked from the same denominations in our common *English* thermometers; his temperate is about our warm air; his warm air, our hot air; and his hot air is about the same with our sultry.

But because every one of my readers may not, perhaps, rightly understand the meaning of thermometer or thermoscope, I shall here explain it: the thermometer is an instrument commonly made of glass, filled with tinged spirit of wine, or some other proper liquor, designed to measure the degree of heat or cold in any particular place, or in the same place at different times and seasons.

At the bottom of this instrument is a pretty large ball of glass, filled with tinged liquor; out of which rises a stem or tube about three or four feet perpendicular: to adjust the degrees of which, the ball may be placed in water which is just beginning to freeze, and then noting the height of the spirit in the stem, make any particular mark against it, O, for example; and graduate it afterwards up and down for heat and cold: this is used with us, and shews us the several degrees of heat or cold in our climate. But besides this instrument, it is necessary our husbandmen and gardeners should be acquainted with some others, which will inform them of the approach of wet or dry

dry weather, that their affairs in the fields and gardens may be directed with some certainty. The first is,

The barometer or baroscope, an instrument for estimating the minute variations of the weight or pressure of the incumbent air; it is a long tube of glass hermetically sealed at one end, and being filled with quicksilver, is inverted so as to have the open end of it immersed or dipped in stagnant quicksilver, contained in a larger glass under it; which larger glass being exposed to the pressure of the outward air (after such immersion) and the quicksilver in the tube suffered to run as much as it will into the stagnant quicksilver, in which that mouth or open end is immersed, there is wont to remain a quantity of quicksilver suspended in the tube, about twenty-eight, twenty-nine, or thirty inches high, measuring from the surface of the stagnant quicksilver perpendicularly; but more or less within such limits, according as the weight or pressure of the air, incumbent on the external stagnant quicksilver exposed to it is more or less, leaving the upper part of the tube void, or at least empty of common air.

The next is the hygroscope or hygrometer, an instrument contrived to shew the moisture or dryness of the air, according as it abounds with moist or dry vapours, and to measure and estimate the quantity of such moisture or dryness. Of this and of the foregoing sort there are many varieties, which I shall mention and explain more fully hereafter, for the advancement of husbandry and gardening; but I cannot conclude this chapter, without observing, that if the method of cultivating this fruit, or any others that are famous in the *East* or *West-Indies*, was rightly understood, we might be supplied with them in every month of the year.

What remains yet to be explained of *Plate Ibid.* is, that C represents the blossom of the ananas in its full

full proportion upon the knot which it grows upon, as it appears at the time of flowering; and that D is one of the knots of the fruit in its full bigness, when the fruit is ripe and has been well managed.

Observations on the management of the ananas or pine-apple, since Mr Telende's method was published, and of the extraordinary growth of the sensitive plant, humble plant, and others, from the warmer parts of the West-Indies.

Since I published Mr *Telende's* account of managing the pine-apples, I find that his extraordinary success has encouraged a great many to undertake the culture of that delicious fruit; and though the stoves which have been built by several gentlemen for that purpose, vary in some little matters from the stove at Sir *Matthew Decker's* at *Richmond*: yet I do not find any of them that has been tried, but what produced some extraordinary effect or other, which leads us more into the knowledge of the humour of that curious plant, as well as others which are natives of the same climate.

The new frame at the physic garden at *Chelsea*, wherein only the use of the tanners bark has been tried this summer, by Mr *Miller*, the curious gardener there, is an instance, that it is not impossible to bring plants of the latitude of eighteen or twenty degrees to the utmost perfection. About the beginning of *August*, I observed the sensitive plants there about seven feet high in blossom, and the humble plants were then preparing to put forth their flowers. The plant called the flower-fence, so much esteemed in *Jamaica* for the beauty of its blossoms, and some others of the same country, are said to be in greater strength than they were observed in *Jamaica*, considering the time of their growth from seed which was put into the ground the spring of the same year; so that now I hope my former expectations and designs will be rewarded, in seeing all the most excellent of the
Indian

Indian fruit brought to perfection in *England*, for where such is the success of a frame designed for summer use, I have no room to despair.

But as for the pine-apples, which I design more particularly to treat of in this place; we have instances of their being brought to extraordinary perfection. There are several stoves now built by curious gentlemen on this account; I shall only take notice of that which was erected this summer in the gardens of *William Parker*, Esq; near *Croydon* in *Surrey*, which indeed commands the attention of all those that have seen it, for its just architecture and good contrivance; the design of it, besides the keeping of tender plants during the rigour of our winters, and the restoring of sick plants, which is common to most stoves, is likewise to ripen some fruits which have been ripened in other stoves here, as well as in *Holland*, and to make new experiments on others that have not been tried; it is therefore attempted to make this stove capable of being heated differently in different parts of it, in order to imitate in some sort different climates, which may be regulated according to the different heights of the thermometer: for these purposes it is so contrived, that in the summer-time it may be useful by means of tanners bark only, and in the winter, both tanners bark and fire may be used together, or fire alone.

I observe in a stove which *Mr Fairchild* has built this year in his garden at *Hoxton* for pine-apples, and the most tender plants; that he has raised his fire-flues above the surface of the floor of the stove, which carries very good reason along with it; for first, as these flues are not buried in the earth, there is no danger of their raising damps in the house; but, on the contrary, if any damps should rise there by any other means, the dry heat which will proceed from such flues, will rectify it, and render it fit for plants, by quickening its motion; for the more rarefied any fluid is, the quicker is its motion; so the less rarefied it is, so much slower
it

it is, or the nearer stagnation, and may become so dense by extream cold, as to have no motion at all, and to be entirely fixed; and the juices of a plant are always more or less fluid, as the temper of the air is more or less hot or cold, or dry or moist; the particles of air are quicker in their motion than the parts of water; and yet the air of our atmosphere is no more than the refined parts of water rarefied by heat, which, upon meeting with cold, are condensed in such a manner, as to be again resolved into water; and this water again, by more extream cold, is fixed into ice; but then from that fixed state, it may again be resolved into its first condition by heat: And this, I think, should be particularly considered by every gardener; for unless he can judge well of the state of air, and how to correct or change it from one state to another, he can never work in this way with any certainty. And for the better pointing out to every one the exact degree of heat, necessary to be observed in a stove for maintaining of the pine-apple, it is, that the thermometer is so serviceable to us.

In the beds of tanners bark that are made for the winter, I find that all the heat they produce is confined within the body of the bark; they yield no perceptible warmth above their surface, as the hot-beds do that are made of horse-dung; so that they are capable only of warming the roots of plants, whose pots are plunged into them; and therefore they should always have an artificial heat by fire, to warm the air above, for otherwise the tender plants, that are plunged into the bark in the winter-time, will be in danger of miscarrying; for it is not to be supposed that the growth of the root can be advantageous to the plant above ground, when the cold air keeps the juices in the vessels of the branches and leaves in a frozen state; so that they cannot move, though the vegetation of the root pushes with never so great a force; and it is certainly the case where there is only heat below, and
none

none above; for experience shews us, that plants languish, if there is not sun enough in the winter to keep the juices above ground in motion; and without the help of fire for that purpose, they will not thrive; but where these two concur (I mean the heat below, and the heat above) then plants do not fail of success, even of such as is very surprising; witness what I have said before of the *West-Indian* plants, under Mr Miller's care at *Chelsea*-physic garden, which have been cultivated from the spring to *September*, only by the assistance of the tanners bark, and the summer's sun.

We are next to consider in what other circumstances the hot-beds of tanners bark and horse-dung differ from one another. First, from the observations I have made ever since I began gardening, I never knew the greatest artist, in the management of the hot-beds made with horse-dung, raise the sensitive plants above two feet high in one summer, nor any of the other *West-Indian* plants above a fourth part so tall as they are at *Chelsea*, in the beds of tanners bark; and this may be owing to two reasons, the one, because the heat in the bark is moderate, gentle, and lasts long; and the other, because it is likely the bark partaking of a large share of richness from one of the strongest vegetables, the oak, and from one of the strongest animals, the ox: I say, these two powerful ingredients fermenting gently in the bark, may be the means of nourishing the plants, whose roots are plunged into it; for though the roots are in the pots, yet we are assured, that either such nourishment may be received by the holes at the bottom of the pots, or else the moisture in the body of the bark may easily be imbibed by the earth, of which the pot is composed, which every one knows is porous enough to receive any humidity or moisture: if this be the case, then the roots may have as much nourishment as they want; for as I said before, there is nothing evaporates from this body of bark that is in the least to be discovered,

Fig. II.

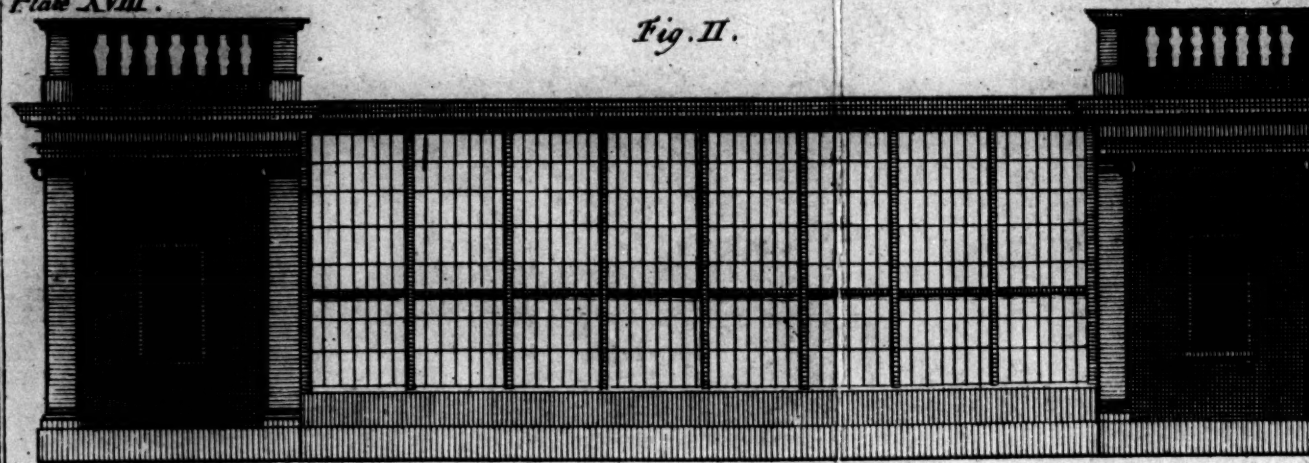
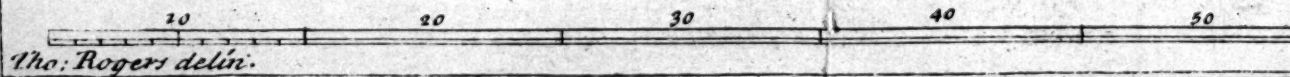
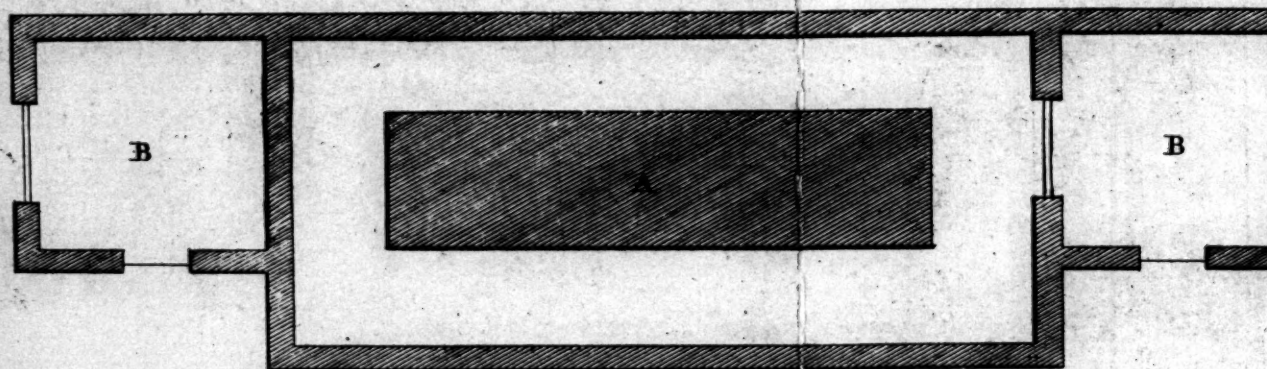


Fig. I.



Tho. Rogers delin.

Fig. I. { Is the Plan of a Stove with a Trench for the Tanners
Bark, at each end is a Room 9 Feet by 8 Feet,
that at the East end hath a Door out of it into
the Stove, and serves the Gardner to lay his tools
in, that on the West is where the Fire is kept, A the
Trench, B. B. The 2 Rooms .

Fig. II. { Is the Elevation of the Front in y^e Ionick Order, wth
a Ballastrade on the top of each end.

Fig. III. Shews the Elevation of the end.

Fig. IV. { Is the Section of the end, which shews the true
Elevation, the Glasß ought to have, there is a
Window in the end .

Fig. III.

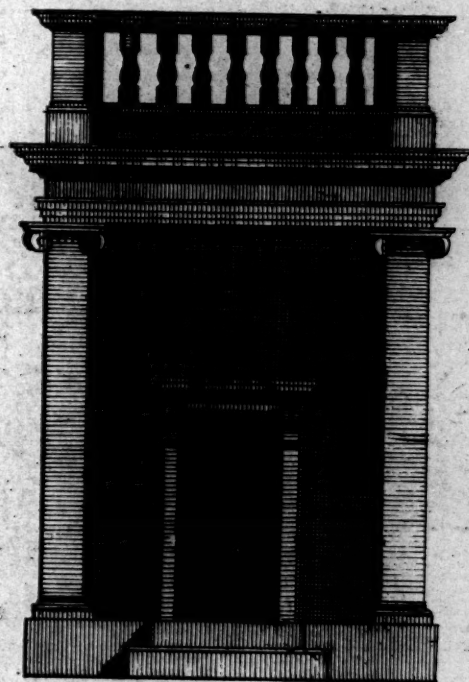
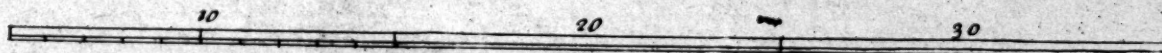
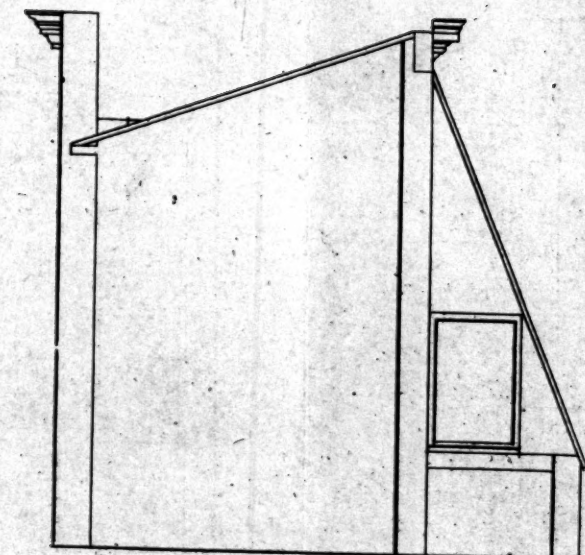


Fig. IV.



so that the roots have all the benefit of this richness to themselves. Now, where so much nourishment is received by the roots or mouths of a body, it is necessary in nature that there should be some discharge, either by the growth of the body, which is only an expansion of the parts of a plant, or a filling of the vessels with more juices; or else by some other way, which will happen as the temper of the air is where the same body resides; whence it is necessary to consult the quality of the air, as well as the diet of a plant, for its welfare.

But it will be necessary that we consider the building a little more: it is observable, that in the frames which are now built for the tender *West-Indian* plants there is near ten times as much air inclosed in the summer-time, where nothing but bark is used, as I have mentioned in Mr *Telende's* account, as was common in the old sort of frames, and yet the pine-apples are in extraordinary health. It is therefore very necessary that the workman who builds the frame or stove, understand what he is about, and particularly how to dispose the fire-place and flues; that he know how to provide the proper regulators for the heat, and the quantity of space such a place should fill; besides the particular disposition of the glasses in the front, which adds extreamly to the welfare of a plant. As for the design of a stove of this sort, I have prevailed with Mr *Rogers*, a very ingenious architect, to compose a draught agreeable to the use required, and to the rules of architecture, which I here present my reader with. See *Plate XVIII.*

It is necessary to observe by the by, that the use of the thermometer is chiefly in the winter, when we make our fires, or give artificial heats; then we are to keep the spirit up to pine-apple heat, or thereabouts, rather above than under that point; but in the summer-time, the natural heat of the sun when it is confined in a frame, will be so much, that the spi-

fit will be up at the top of the tube; but yet, that heat in summer, with the addition of the tanners bark to the roots, is no more than necessary for the ripening of the fruit, as the artificial heat in the winter is necessary for the growth of the plants.

CHAP. XV. *Further instructions relating to the construction and uses of the barometer, hygrometer, and thermometer, in a letter to W. Waller, Esq;*

S I R,

BAROMETERS will be of particular use to farmers, by assisting them to elect proper times, for sowing and reaping.

The rules and observations made for knowing the weather, by the various rising and falling of the weather-glass or barometer, are these:

1. That the least alterations in the rise and fall of the mercury in the tube, should be regarded, in order for the right finding the weather by it.
2. The rising of the mercury presages fair weather, as the falling indicates the contrary, *viz.* rain, snow, high winds and storms.
3. In summer, if the quicksilver be up about fair, and the weather very hot for four or five days, then we may expect black clouds to rise, and a brisk gale with thunder, and a shower or two, which will soon go off.
4. In winter, the rising presages frost; and in frosty weather, if the mercury falls three or four divisions, there will certainly follow a thaw; but in a continued frost, if the mercury rises, it will certainly snow.
5. When foul weather happens soon after the falling of the mercury or quicksilver, we are to expect but little of it; and judge the same with respect to fair weather,

weather, shortly after the mercury has risen in the like manner.

6. In foul weather, when the mercury rises much, and so continues two or three days before the foul weather is over, then may we expect a continuance of fair weather to follow.

7. In fair weather when the mercury falls much, and continues for two or three days before the rain comes, then we may expect a great deal of wet, and high winds.

8. An unsettled state of the mercury denotes uncertain and changeable weather, as sun-shine, some black and white clouds, with frequent showers.

9. If the mercury be up at fair and does not fall, and it happen to rain, then we may expect but little of it.

10. If the mercury be down at rain, and does not rise, and the weather proves fair, then we may expect it not to continue.

11. We are not strictly to mind the words that are engraven on the plates, though for the most part the weather will agree with them; for if the mercury stands at much rain, and does rise up to changeable, it presages fair weather, although it is not to continue so long as it would have done if the mercury was higher; and so on the contrary.

But to know how to judge still with greater certainty of the alteration of the weather, we may accompany the foregoing instrument with an hygrometer, which will forewarn us of wet and dry weather, by pointing to us the degrees of moisture or driness in the air, and how one or the other increases. The best instrument I know of this kind is made of a catgut, about a yard in length suspended, having a plummet or piece of lead, with an index or pointer hanging at the lower end, by which means the catgut will twist or untwist as the air dries or moistens, and shorten or lengthen so as to raise and sink the

plummet with its index, which will mark the degrees we seek after: the weight of my lead is about two ounces; but some who use fine whipcord instead of cat-gut, put a greater weight of lead.

The twisting or untwisting of either the cat-gut or cord occasions the lead with the index to turn round, as well as rise and fall; so that I chuse to mark my degrees upon an open skrew of brass, within which the plummet and index has its motion. There may be many devices for the figure of the weight or plummet, as a *Cupid* with an arrow in his hand to point at the degrees; or a bird with wings extended for flight, with some bough or branch in his mouth to serve for an index: these figures may be gilded for ornament sake; others may be contrived as fancy directs.

When we are provided with these two instruments, we should compare the motions of one with the other, in order to judge what proportion the rise or fall of the quicksilver in the barometer bears to the twisting of the cord or cat-gut, whose degrees of motion we may observe by the index or pointer of the hygrometer; and at the same time compare both these with the risings and fallings of the spirit in the thermometer, to know what degree of heat or cold attends every different change of weather.

The thermometer shews, by inspection, the present condition of the air, whether it be hot or cold; which day in summer is hottest, and in winter coldest, or any part of the day; and from thence many useful experiments have and may be made, viz. discovering the hottest or coldest bath, or the degrees thereof. So likewise of any spring, how much one exceeds the other in coldness.

When I can persuade my brother planters to use these instruments, I hope they will, in their respective stations in and about *Britain*, make remarks upon the several motions of them, and fixing *London* as the standard, communicate what remarks they make in
the

the several countries they reside in; for by comparing one with another, we may come near a certainty what plants will grow and prosper in every part of the kingdom; and from many observations of that nature draw such conclusions as may be of universal benefit.

I am, SIR, Yours, &c.

R. BRADLEY.

As I have taken occasion to publish this letter, I think it not amiss to prescribe a method for some of my readers to follow, in the accounts or observations they make on the alterations of the instruments named in it, *viz.* the barometer, hygrometer and thermometer.

The method I shall propose, is that which is practised by the order and direction of the honourable *Samuel Molyneux, Esq;* to whom the learned part of the world is obliged for many great discoveries.

To give an example of this method according to the directions prescribed by the aforesaid curious gentleman, we are to provide a book for twelve months remarks, which should be made six times every day. At which times is to be observed,

1st, The rising or falling of the quicksilver in the barometer. 2^{dly}, The alteration of the hygrometer. 3^{dly}, The rise or fall of the spirits in the thermometer. 4^{thly}, The point of the compass from whence the wind blows, and as near as can be guessed with what strength. And 5^{thly}, Whether rain, snow, hail, &c. and what quantity fallen.

Each leaf of the book designed for this use should be divided into several columns; the first for the day of the month and of the week: the second, for the number of inches and parts of an inch in the tube of the barometer, where the quicksilver stands at the time of observation: the third, to mark the degrees pointed at by the index of the hygrometer at the same

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time: the fourth, to shew the number of inches and parts of an inch in the thermometer, where the spirit stands at the time of observation: the fifth, to mark the winds, and their strength: and the sixth, for the quantity of rain falling, and disposition of the clouds and air.

CHAP. XVI. *Observations concerning the propagation of plants from the hottest climates, and the methods of naturalizing them with us; as also proper rules for gathering of seeds abroad, and the method of transporting them from one country to another with safety.*

To Mr BRADLEY, &c.

SIR,

SINCE you are arrived to that perfection, as to be able here at home to make climates answerable to any whatever assigned abroad, and produce equatorial heat in the latitude of fifty-one and a half; and since by that means we shall be able to propagate in *England* whatever fruits, plants, or flowers, which being either useful, curious, or profitable, are produced in the warmer climates; I believe, it will not be improper that seamen cultivate a correspondence with you, since thereby they may perhaps inform you of several plants but little known in our *English* gardens.

Indeed, two things have prevented sea-faring persons from bending their thoughts this way. First, a persuasion that vegetables produced in those hot climates cannot live with us; which impediment you have now removed, by your stoves, hot-beds, &c. The second is, that seamen being but little acquainted with the vegetable world, they know not which are rarities, and which not; which you have already got,

and

and which are entirely unknown to you: this difficulty I hope you will also remove by publishing a catalogue of such exotics as you have already; and also, what others you would chiefly wish to be brought you; and likewise the methods of doing it with most likelihood of success. In the mean time, I shall venture to mention to you some things which I thought most remarkable when I used the sea; not doubting your candid acceptance of my good intention, however imperfect my relation may be. And the first thing I shall take notice of, is the palm-tree of *Guinea*, the juice of which is not only a pleasant drink, but also reckoned so effectual against the stone, that I have heard the old *Guinea*-surgeons give it as their opinion, that it would as easily dissolve the stone in the bladder, as water does loaf-sugar: and I can speak on my own experience, that it is a most excellent diuretic, and so effectually cured me of the gravel, that I have not been troubled with it for these twenty three years past.

Palm-oil is also excellent in several cases, as aches, sprains, bruises, swellings, and is also often taken inwardly by the negroes; but for what distempers I had not language enough to inform myself.

Their yamm is of the potatoe-tribe, but vastly larger; it is more mealy, of a larger but whiter grain, which shines like that of double-refined sugar, and is extremely nourishing.

The cocoa-nut is pleasant to the taste, and the milk or water contained in it diuretic; but the tree being very tall, and a slow grower, will hardly be worth our attempting here.

The water-melons are a most curious fruit, and deserve our greatest application; there are two sorts of them, the red and the white, but the red are best. They are eaten commonly cut out in slices, but the pulp mashed, and when eaten with *Madeira*-wine and loaf-sugar, are incomparably fine.

I come now to our *West-Indies*, where they have a red potatoe, which is as sweet as a parsnep: and at *Barbadoes* they make of it a very pleasant drink, that they call mobby, which I believe would take mightily with our quality here in summer; for it cools, and must be good against consumptions, as all the potatoe-tribe are; and, to take off the windiness it contracts by being bottled, it is generally drank with wine.

The *Barbadoes China*-orange far exceeds the *Lisbon* in the richness of its juices. They here have also a fruit of the orange-tribe called a shaddock; it is from four to eight times as big as an orange: it is a most noble fruit to look at, and not unpleasant to the taste; besides, the blossom is very large, sweet and fine, like the orange; there are two sorts of it, the red and the white; the red is the preferable.

The guava is a very good fruit, so is plantain; but the banana is very fine, and could it be produced here, would answer the cost and trouble. The lime is very good against the scurvy, and some prefer punch made with it to that with lemons: it is hardy, and whereas it grows well in the island *Majorca*, where they have sometimes much snow, I doubt not but it would thrive with us, and make a most beautiful ever-green hedge. I wonder the sugar-cane has never been attempted in our stoves, upon the account of its being the finest of pickles.

The mango of *Malabar* would be of great account in our gardens, and would be prized more for the deliciousness of the fruit, than the excellency of the pickles. And since I am upon the subject of pickles, I have heard that our large white plum has been attempted with success that way; and that the small capers of *Majorca* are thought to exceed the large ones of *Toulon*.

The *Indian* corn is what I believe would very well deserve our cultivating here; for if an acre of reeds is worth

worth two acres of corn, here you would have reeds and corn too; and the corn (besides several other uses) is so excellent for fattening hogs, that it makes their fat hard as brawn, and not flabby, as ours generally is: the reeds make a lasting and impenetrable thatch, small fence, &c. and the produce is prodigious.

The cranberry would also be very well worth our care; it would bear our winter abroad extreamly well, and would require the stove only in summer, when your other exotics are all abroad.

It is also a pity that no body attempts to make the prickle-pear of *Jamaica* useful: I am persuaded it would make a beautiful and lasting dye, if any ingenious person would set heartily and in good earnest about it.

When I reflect on that eternal verdure, which reigns over all that part of the torrid zone that I have been in, I wonder from whence it is, that nature supplies those vast trees and other vegetables with moisture sufficient to maintain them, not only with life, but in flourishing beauty, without one drop of rain for six months together, a parching sun daily exhausting them, and the earth so dry, as to be cleft several yards deep. Should I conjecture it is from the vast dews that fall every night, it would thence undeniably follow, that there is a circulation of the juices in vegetables; and that the branches assist the roots, as well as the roots the branches. But this is a piece of philosophy not yet universally established, and which I must leave to your greater genius and experience to enlarge upon. Being, with all submission,

SIR, Your most humble servant, S. C.

The foregoing letter has three things in it, which I esteem to be highly considerable in point of gardening, and its use. The first is, that concerning different climates, and their being artificially imitated with us. The second relates to the finding out the best methods of

of importing foreign plants to this kingdom; and the third relates to the necessity of making known to the world, the uses and virtues of such exotic plants as are brought to us.

As to the first part of these, which intimates, that we have in some measure imitated the warmest climates of the world here in *England* by artificial heats; it is true, we have now in practice several ways, which have been lately tried for the production of heats of almost every degree necessary for the welfare of plants of foreign countries; and the last year has given me the pleasure of finding, that those methods, I have recommended in my former papers, have had such good success, that more gentlemen have taken that part of gardening upon them, in the last twelve months, than has been known for many years before.

Tanners bark is of extraordinary use for making plants strike root quickly; and as there is little or no steam rises from it, so the leaves of such plants will not be endangered, as oftentimes those are which are set upon hot-beds made of horse-dung. We must observe too, that the bark, when it is just taken out of the vats, is subject to heat with violence, and grow mouldy on the top, and then speedily lose its heat; but the bark should have been out of the vats about a fortnight before we use it; in which case it will heat gently and gradually, and continue hot a long time (a).

The second thing to be considered is, the method of importing plants and seeds from foreign countries with safety; and how such gentlemen as go abroad may judge of the plants they meet with in foreign parts, whether they may be acceptable to us, or not.

As to the bringing over of seeds and plants, I shall only take occasion here to mention two or three new particulars which are necessary to be observed in those cases:

(a) See Part II. Chap. 10. Note (a).

cases: I have already said, that it is the best way to gather the seeds in their shells and cases, and so to bring them to us; for besides the help such cases will be of to preserve the seeds during the voyage, they will help to inform us of what class or order the plants are of which they were taken from; or if we have occasion to bring over plants in boxes of earth, we may sow some of the seeds in those boxes of earth, especially those of the tree-kind, because by that time they come to us, they may be in some forwardness to grow. But if we have not this convenience, we may follow the method communicated to me by a very curious gentleman; which as it carries the appearance of great reason with it, has my approbation, and it is this: when the seeds are gathered, and as well dried as the warmth of the air of the place can do, or a warm pocket will do in three or four days, then put them into a glass-bottle, or glazed vessel, closely stopped, rather with a stopple of the same sort than with a cork, for a cork is apt to rot by change of air; and then we must take care to have this stopple well cemented with pitch, or bees-wax and rosin: the said vessel must then be placed in a larger jar, or vessel of glazed earthen ware, and the intermediate space between both must be filled with common salt, even so as to cover the stopple of the seed-bottle. By this means, I judge, it will be impossible for any of the seeds to be injured in their passage through different climates; for yet I cannot discover, that any sort of insect can live in a body of common salt; or where salt is the medium justly regulated between the air and the body, then such body cannot putrify so as to be rendered a proper nidus for any insect to lay its eggs in (b).

This

(b) In sending seeds from one country to another, the great care to be taken is to secure them from vermin and preserve them dry, otherwise they will mould and decay. The method

This salt also corrects the extraordinary heat of the warmer climates, and by its being thus made the wall, as I may call it, between the hot air and the seeds, so through its fixation and coldness, it is not to be supposed, that the excessive heat of the hottest climates can penetrate through it, so as to occasion any considerable decay in the seed. And we may consider likewise, that as this salt is first fixed by extraordinary heat, so we cannot suppose, that while the seeds are passing through the hot and dry climates, the salt can suffer any great change or alteration; and so it is as natural to suppose, that the seeds which are under its shelter cannot be much altered; and we well know, that a climate about the latitude of ours is rarely disposed to melt salt, so that under such shelter we can hardly find any seeds brought to us that will not be in good perfection.

We are next to consider of the best means for the transportation of the plants themselves, and that may be done, in a short voyage, without any earth about the roots, if they are trees of any substance; that is to say, of an inch, or an inch and a half diameter in the stem; but they must be very clear of wet before they are

thod Mr *Gatesby* always observed was to put his seeds dry into papers, and then put them into a dry gourd-shell and seal them up. There are some persons who have directed to put them into glasses and seal them closely down, to keep out the external air: but from several experiments of this kind, which I have made, I find seeds thus closely put up will not grow if they remain stopp'd up any considerable time; all seeds requiring some share of air to preserve their vegetating quality, so that where a person has no other conveniency, they may be put into a bag and hung up in a dry part of the ship, or put in a trunk where they may be safe from vermin, in which places they will keep very well.

It is the safest way to bring all sorts of seeds in their pods or husks, wherein they grow if they are put up dry, because their own covering will afford them some nourishment if it be seeds that are not separated from the placenta. *Miller.*

are packed up, otherwise there will be a ferment about their bark which will destroy them. I have known some trees which have grown after they have been without earth for ten months, orange-trees especially; and a willow-twigg, which I used to carry in my hand for more than ten months, is now, after sticking years in the side of a bank, become a good tree.

But for the transportation of plants, which require earth to grow in while they undergo a long passage, I can give no better directions than what I have lately observed in a letter of Mr *Mark Catesby*, a very ingenious gentleman, written from *Carolina* to Mr *Fairchild*, concerning the carriage of plants by sea, which he has had good experience of, as appears from the many varieties of *Virginia* plants, which of late years he has sent over to *England*; and is as follows.

SIR,

I desire when you send plants by shipping to remote parts, to send them in tubs, and not in baskets; for baskets contribute much to the miscarriage. Winter is the best time for this purpose; *October* if it could be done then, the tubs should be put in ballast, which keeps them moist and moderately warm. So managed, I have had best success with plants from *England*; for on the quarter-deck they are often wetted with salt water, and require the greatest tendance from bad weather, and even with the greatest care they miscarry, as they did with me. It is so hot in the hold in summer, that they spend their sap at once, and die, so that that is not a time to send any thing (c).

MARK CATESBY.

(c) In sending plants from one country to another, great regard should be had to the proper season for doing it: for example, if a parcel of plants are to be sent from an hot country to a cold one, they should be sent in the spring of the year that, as they come toward the colder parts, the season
may

I had almost forgot one thing relating to the carriage of seeds from one place to another, which this gentleman

may be advancing; and hereby if they have suffered a little in their passage, there will be time to recover them before winter; whereas those which arrive in autumn are often lost in winter, because they have not time to recover and get root before the cold comes on. On the contrary, those plants, which are sent from a cold country to an hot one, should always be sent in the beginning of winter, that they may arrive time enough to be rooted before the great heats come on, otherwise they will soon perish. The best way to pack up plants for a voyage, if they are such as will not bear to be kept out of the ground, is to have some strong boxes with handles to them, for the more easily removing them in bad weather: these should have holes bored in the bottom, to let out the moisture, otherwise it will rot the roots of the plants; over each of these holes should be laid a flat tile or oyster-shell to prevent the earth from stopping them; then they should be filled with earth, into which the plants should be set as close as possible to each other, in order to save room, which is absolutely necessary; otherwise they will be very troublesome in the ship; and as the only thing intended is to preserve them alive, and not to make any progress while on their passage, a small box will contain many plants if rightly planted. The plants should also be placed in a box a fortnight or three weeks before they are put on board the ship, that they may be a little settled and rooted; and during the time they are on board they should remain, if possible, on the deck, that they may have air: but in bad weather they should be covered with a tarpawlin to guard them against the salt water, which will destroy them, if it comes at them in any quantity.

The water these plants should have while on board, must be proportioned to the climate whence they come, and to which they are going; if they come from an hot country to a cold one, then they should have very little moisture after they have passed the heats: but if they are carried from a cold country to an hot one, they must have a greater share of moisture when they come into a warmer climate; and should be shaded in the day from the violent heat of the sun, to which if they are too much exposed, it will dry them up and destroy them. *Miller.*

gentleman usually practised with success, which was, that he always used to put the seeds in the shell of a gourd, and seal them up; by which means I have not known any of them miscarry; in the several parcels which he has sent from *Virginia* to *England*.

Now as we are come thus far, it is necessary that we observe, that a catalogue, however useful it is, of those plants which will be acceptable to us, would fill up a larger volume than I propose here: besides, we are ignorant of many of the names, given them by the people of the countries where they grow, and to call them only by the names given them by our botanists, would not be intelligible to any but such as have studied botany; so that at present, I know no better way, than advising in general all those gentlemen who use the sea, and are disposed to collect either plants or seeds abroad, to let them be chiefly of such sorts as are useful in their timber, or in their wood for dying, or in their roots, fruits, &c. for physic or diet. Indeed, so far we may venture to prescribe, in particular, that the guava be brought over to us in plants, suppose of an inch diameter in the stem; and likewise the tamarind, in the same state, might be made to prosper with us; and so too the plantains and bananas of the *West-Indies* should be brought to us in plants of some strength, if we expect to have the desired success with them; the cinnamon-tree also from *Ceylon*, the pimento from *Jamaica*, and any other spice-trees rather in plants than in seeds; or if the fresh seeds of the nutmeg could be gathered, they may be planted in a tub of earth about two inches deep, or coated with clay about two inches thick, or dipt in bees-wax. Ginger without curing, if the roots are moderately dried in the pocket or the sun, will come well to us: the mango is likewise very desirable, and I doubt not, but the stones, if they are preserved in clay, or bees-wax, or earth, may be easily made to grow here with our stoves. I am persuaded,

suaded, by some experiments, that all plants which have resinous juices will bear our climate without shelter; for a vast variety of those kinds in the open ground have been tried, and some of them, which are natives of the warmer climates, are as little damaged by our winters, as if they were natives of our own climate; and I have found, that the plants of *China* and *Persia* do very well with us. As for melons, water-melons, gourds, or pumkins and squashes, we have already, I believe, most of the sorts, though there are few among us that use their fruit, except that of the first sort.

I find, that the lime and wild-lemon are apt to bear fruit plentifully with us, and to ripen their fruit well, which is a certain sign of their agreeing with our latitude; and all the orange or lemon-race are hardy enough to stand the winter with us, in common green-houses; and even some are hardy enough to stand abroad in our most southern quarters.

Among other things, I would desire, that the rivers, bogs and lakes, in the several foreign countries, be examined; and that, without scruple, the seed of any herb or plant growing therein, if it has seed which is ripe or near ripe, be gathered, and put into an earthen vessel, with water and earth. Some of these ripen their seed under water. They might thus be brought to us, and if it is remarked, whether they grow in running or standing water, we can easily propagate them with us. In these sorts of plants, any one may be sure to bring us something new, if he will take the pains to gather the seeds; for, as yet, I do not know any but myself, who has brought any new water-plant to *England*, or has ever attempted it; and some of them are very surprising in their manner of growth. I could wish likewise, that we could get some plants or seeds of pepper to grow with us, and some of the true rhubarb, if possible, for this last has never yet grown in *Europe*, so far as I can find.

But

But I come now to my third and last proposition, which is, that when we gather plants abroad, we should, if possible, learn the names they are called by in the country, and their use or virtues, and take some notice of their soil and situation, but especially the climate; and, if it could be done, we should know the humour of every climate a plant is brought from, that is, how long the heats last, and when the rains begin to fall and terminate; for by these hints we may be sure of making every plant lasting and valuable to us, which may be brought from any part of the world.

CHAP. XVII. *Particular observations concerning the culture of the coffee-tree, and other tender exotic plants, &c. in a letter to William Parker, Esq;.*

SIR,

I Remember an observation you was kind enough to acquaint me with, which I think very extraordinary, *viz.* that among your experiments in setting foreign trees abroad in your garden, you found that such plants as had resinous juices would bear our winters, though they were natives of much warmer climates than any I have mentioned; and indeed there are witnesses enough in your garden of that sort. If we were to follow this example rightly, I suppose in a few years our woods and groves would be adorned with many rich and useful trees, which, at present, through the fear we have of venturing such curiosities abroad, are hardly esteemed worthy our notice, or are at least neglected as useless things in our climate; for though we can with the greatest facility preserve them during the winter-season in houses, yet, as the end of the trees I mean is chiefly to make good timber, or to yield some benefit from their berries or fruits, which they

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will /

will not produce till they are of a much larger size than we can manage in a house; so it has been hardly thought worth our while to cultivate them at all, considering the great expence we must be at to no other purpose than for the sake of curiosity only. Indeed, that houses of shelter are necessary to preserve such plants during the winters, for the first two or three years, till they have got strength, is undeniable; and as soon as they come to such a state, as to be a little acquainted with our climate, by being hardened by degrees, to set them abroad in groves as you have done, is as necessary; and they will then thrive apace, and give us not only the pleasure of observing their variety, but likewise a promising prospect of receiving benefit from them. The ilex, though the value of its timber has for a long time been well known, besides its being a most beautiful ever-green, yet, though we have had examples of forty years standing, that it would prosper well in the open air of our climate, very few or none have offered to cultivate it in any quantity with us, till I entered upon it: and since that time, which is within the compals of six years, many millions of them have been raised here from acorns brought from *Italy*, *Spain*, and *Virginia*; as well as great numbers of cork-trees, which grow very well with us. But if there are some trees abroad, in the climates I speak of, whose virtues are not yet known, my opinion is, that even those should not be neglected; for as there was nothing created in vain, so I suppose that these will some time or other discover themselves to be of use, as well as those have done which are now useful to us. But since the arrival of your coffee-trees, and the great design you are carrying on, of bringing forward the delicious fruits of the warmer parts of the world, by stoves, or hot-houses, I shall, in obedience to your commands, give you an account of the management of the coffee-tree, as I observed it at the physick-garden at *Amsterdam*; and I shall add to it
some

some remarks I have got together concerning the spring-seasons in the several climates of the world, to save you the trouble of calculating in particular for every plant you receive from abroad; for without that be done, we may give our plants heat at a wrong season, and weaken them, perhaps, beyond recovery.

The coffee-trees at *Amsterdam*, which prosper so well there, that they bring blossoms, and ripen fruit every year, are kept constantly in a glass-case, which, as near as I can guess, is about fifteen feet long, and twelve feet wide, and the height about twenty feet; the front being all glass; under the floor is an oven for fire, which leads into flues, that after their passage here and there, end in a chimney-as our other stoves do. They use no tanners bark in this house, nor give the plants any air immediately from abroad all the summer, but through little casements about a foot square, placed about the middle of the great windows or panels of glass; and even these little casements are seldom opened, because there is a door which opens out of this glass-case into a large green-house, which they commonly keep open in the summer-time.

It is a custom there likewise, twice or thrice in a summer, to clean the leaves of the plants with wet sponges, which takes off the dust that stops the pores of the leaves; and I look upon this to be of considerable use, because I suppose the leaves receive some nourishment from the air, which circulates about them, and consequently the whole plant is benefited by it.

I observed that the gardener there gave them frequent waterings, a little at a time, their earth being very light; but especially in summer, when the green fruit was toward ripening, he gave them more water than at other times. It is observable, that when the fruit is ripe about the beginning of *July*, it must be gathered, and immediately the seeds must be cleared from the pulp, and set in the ground, otherwise they will not sprout.

As for the time of making the fires in the stoves, they begin in *October*, and continue them constantly, till the weather is warm enough in the spring for the plant; I suppose this continued fire in the stoves is necessary to continue the growth of the plants, when the juices are once flowing; for to warm the house one day, and to let it cool the next, will certainly check the growth of a plant; and this method, which we have taken too often in our *English* green-houses, has, in my opinion, greatly contributed to destroy many a good plant. And then again, the practice which has been so common with us to set plants of all climates together in one house, and give them all heat at the same time, has been another means of destroying plants; but as your stove is contrived in such a manner, as to be separated one part from the other by a partition, so, I judge, your heat may be governed so as not to be every where at the same time alike, and therefore may bring plants of different climates to perfection.

The coffee-tree, which grows naturally in the kingdom of *Taiman* in *Arabia Felix*, is found from the latitude of 18 to 20 degrees north; and the *Dutch* now have it growing at *Batavia*, 7 deg. south latitude, and at *Surinam*, 8 deg. north. Thence I doubt not but in any of our settlements between the tropics, we might have coffee in as great perfection as in its native country; and even towards the southermost parts of *Carolina* (a).

And

(a) The coffee-tree is propagated by seeds, which should be sown soon after they are gathered from the tree, for if they are kept but a short time out of the ground, they will not grow, which is the chief reason that this tree has not been spread into more different countries; for the seeds will not keep long enough to be sent into any place; so that in order to cultivate this plant in any part of the world, it is absolutely necessary to have it carried thither growing. The berries of this plant are commonly ripe with us in *April*, at which time they should be sown in pots of fresh light earth, covering them
about

And now, Sir, I think it may not be amiss to send you likewise the following memoranda, for the use of

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your

about half an inch thick with the same light earth; then plunge the pots into a moderate hot-bed of tanner's bark, observing to refresh them often with water, as also to raise the glasses in the heat of the day, to admit fresh air; and in very hot weather, it will be proper to shade the glasses with mats, otherwise the earth in the pots will dry too fast, and prevent the vegetation of the seeds. I must observe, that the taking off the pulp of the berries, which has been by some people directed as absolutely necessary, is a great mistake. When this plant is removed, great care should be taken not to break or injure the roots, and also to preserve the earth to the roots: nor should they be kept any time out of the ground, for if their fibres are suffered to dry, they are very subject to mould and perish soon after.

The soil in which I have observed these plants to thrive best was composed in the following manner, *viz.* one load of fresh, light, loamy earth; one load of rotten cow-dung, with half a load of sea-sand: these were well mixed together and laid in an heap six months before it was used, in which space it was turned several times, the better to incorporate the several parts.

The coffee-tree has of late years been much cultivated in the islands of *America*, both by the *English* and *French*, but the coffee which has been brought to *Europe* from thence has been very little esteemed. This great difference in the goodness many have attributed to the soil, in which it grows, and therefore have supposed it impossible for the inhabitants of the *British* islands ever to cultivate this commodity to any real advantage, but this is certainly a mistake, for I have been assured by several persons of credit, who have resided in these islands, that the berries which they have gathered from the trees, and roasted themselves, were as well flavoured as any of the coffee which is brought from *Mocha*; so that the fault is in the drying, packing, and bringing over: for if in the drying of the berries they are laid in rooms near the sugar-works, or near the house where the rum is distilled, the berries will soon imbibe the effluvia of these, which will greatly alter their flavour. Also the coffee brought in the same ships with rum and sugar, were the coffee ever so good, would by this be intirely altered. *Miller.*

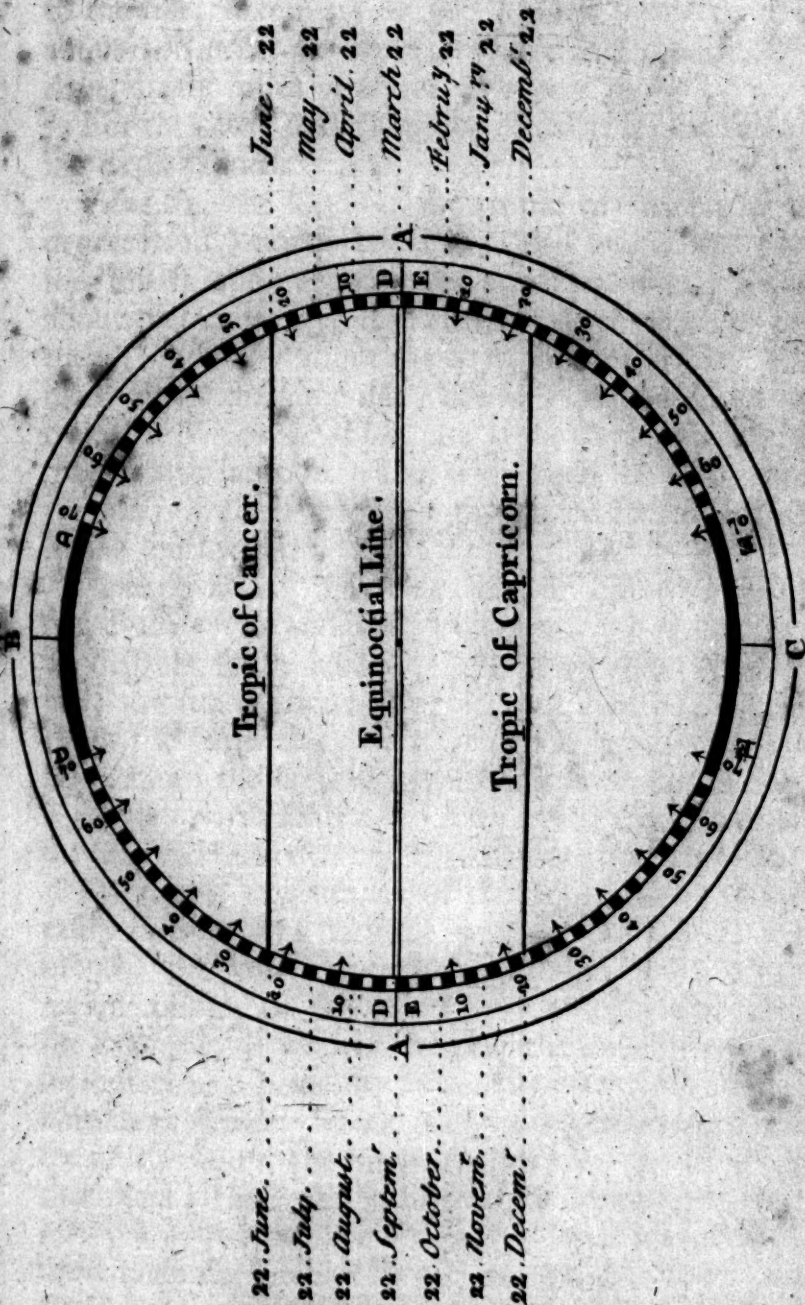
your gardeners, that, knowing the climate natural to any plant, they may the better know at what seasons the sun is nearest to any particular place, and in what months farthest from it, that the fires may be regulated accordingly. The *Fig.* in *Plate XIX.* represents the terrestrial globe, with the equinoctial line, and the two tropics; whereby they will find that the extent of the sun's progress is 47 degrees from the tropic of cancer to the tropic of capricorn; and that the sun has its course from tropic to tropic twice every year: I think it proper, as I now talk to gardeners, who, perhaps, have not had the opportunity of any great share of learning, to treat them upon this head in the most easy and familiar way, and talk of the sun's motion backwards and forwards, as they generally understand it, rather than to perplex them with speaking of the earth's motion, which they, perhaps, cannot comprehend.

From A, A, to B in the said figure is north latitude. From A, A, to C is south latitude. From D towards D we shall find the degrees of north latitude marked 10, 20, 30, 40, 50, which is near the southernmost part of *England*, *London* being in 51½ degrees. From E towards E we find the degrees of south latitude marked 10, 20, 30, 40, &c.

Every division in that circle of degrees, whether it is marked black or white, is two degrees, or 120 miles.

The sun is upon the line *March 21*, and also upon the same line *September 21*; so that at either of those times the sun's influence is equal on both sides the line at equal distances from it: all the south latitudes having the same share of it as the corresponding circles of north latitudes.

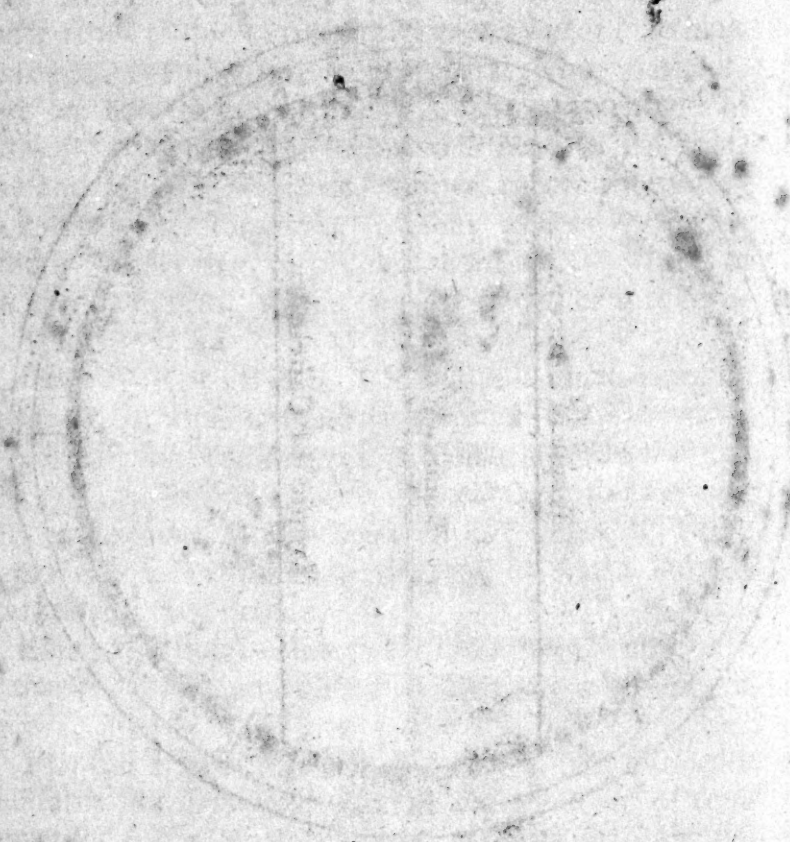
The sun is at the tropic of cancer, *June 21*, which is the utmost extent of its course northward; this tropic is 23 degrees and ½ north of the line; then reckoning sixty miles to each degree, there are 1410 miles between



Sun's Course to the South
or from Britain,

Sun's Course to the North
or to Britain.

South Pole.



between the tropic and the line; which is the progress of the sun in thirteen weeks, or a quarter of a year; so that in the sun's course from the tropic of cancer to the line, it retreats 15 and $\frac{1}{2}$ miles every day, or about 108 miles *per week*; which in a month of 30 days is 465 miles or above 7 degrees and $\frac{1}{2}$.

For the better understanding of this, see the following explanations.

June 21, the sun is in the tropic of cancer, or 23 degrees and $\frac{1}{2}$ north latitude. *July* about the 21st, the sun is about 16 degrees north latitude. *August* about the same day, it is about 8 degrees north latitude. *September* about the 21st, upon the line. *October* about the same day, about 8 degrees south latitude. *November* about the same day, near 16 degrees south latitude. *December* about the same time, the sun is in the tropic of capricorn, its farthest bounds to the southward.

January about the same day, it has returned or come nearer to us about 8 degrees, and is then near 16 degrees south latitude. *February* about the same day, the sun is about 8 degrees south latitude. *March* about the same day, the sun is returned to the line. *April* about the same day, the sun is advanced to about 8 degrees north latitude. *May* about the same day, the sun is advanced to about 16 degrees north latitude.

From this explanation of the figure, any one may easily find out the latitude wherein the sun is every month, and how it approaches or goes farther off the native country of the plants we design to cultivate; for example, if we were to keep the nutmeg-tree, let us look in a map, or any table of latitudes, &c. for the latitude of *Banda*, which being 4 degrees south, then see in the figure the months when the sun is nearest that place: these we shall find to be *September* and *October*, and *January* and *February*; in these months we must keep fires in our stoves, at least up to the pineapple heat; and so indeed the fires must be still kept

on from the first lighting in *September*, till we may place them in a glass-case in tanners bark, which may be done about the middle of *April*, and continued till the time we begin to make fires again in *September*; for we must consider, that places so near the line are always very much under the sun's influence, though more at one time than another; so we should only give such plants air directly from abroad in the hottest days of summer.

Suppose, in the next place, we were to propagate the tea which grows in *Cbina*, let us look for the latitude of *Cbina*, which we shall find to extend from 41 to 20 deg. north latitude. I shall suppose that the tea grows about the middle of the country, which is 30 degrees north, or about the same latitude with *South Carolina*; then as we have plants from the south parts of *Carolina*, which after a little care to harden them, will stand abroad with us, I make no doubt but the *Cbina*-tea, which appears to grow about 30 degrees north, may be easily propagated with us; and it might prosper exceeding well, if it were planted in *South Carolina*, from whence we might soon bring large quantities, if it was once planted there, and make three or four returns for one *Cbina*-voyage. And as to the propagating of it in *England*, if we were to give it shelter in the winter, we may see by the figure that the summers in *China* are only a little earlier than with us, and the winters are of course much about the same time; besides, as 30 degrees are out of the tropics, there need not be any artificial heat applied, or any other care taken to preserve the tea with us, but to give it some little shelter in extream frosty weather; and it is a query whether even that be necessary or not; for we must be careful not to give heat to a plant that does not require it. This we have experienced in the propagation of the caper; we used to put it into our warmest stoves, and took a great deal of pains with it to no purpose, till I sowed

it in some old walls, and gave it the free air, and then it answered the end of bearing flowers as well as it does at *Toulon*.

While I am speaking of transplanting these riches from one place to another, I cannot help wondering, that the cochineel, which is plainly an insect, is not industriously propagated in our *West-Indian* settlements; seeing it might be done only by transplanting one of the sorts of opuntia's whereon this insect has laid its eggs, which alone would soon fill a country with it, as well as the plant necessary for it to feed upon.

For a third example, let us consider *Barbadoes*, whose latitude is in 13 deg. north, whether or not the sun in its greatest distance from it be more than the sun is from *England* in the longest day? We shall find by the figure that at the shortest day with us, the sun is distant from *Barbadoes* 36 and $\frac{1}{2}$ degrees; but in our longest day the sun is only distant from us 29 degrees, which is 7 degrees and $\frac{1}{2}$ that the sun is then nearer to us than it is to *Barbadoes* at our shortest day. I have heard that the nutmeg-tree was once in *Barbadoes*, and prospered very well; and I see no reason why we may not try it in that island once more, or at least the cinnamon, which now grows in *Ceylon*, whose latitude is from 10 to 6 north.

Considering the latitude of *Jamaica*, which is 18° north, no place could better fit the coffee-tree than this; also the most southward of the *Caribbee Islands* would do very well for the pepper, clove-trees, and any of the spices, for the nutmeg grows in 4 degrees north, the cloves in the island *Ternata* 2 degrees north, the pepper in *Borneo* 6 degrees north, as well as under the line, and the cinnamon at *Ceylon* from 10 to 6 north; so I doubt not but they would all do well in the south of the *Caribbee Isles*, which lie in 10 degrees north, for even 10 degrees difference between
the

the tropics is of little import to plants which are natives of the torrid zone.

There is one example more I think necessary to offer, and that is, if we receive plants from the *Cape of Good Hope*, the latitude of which we shall find to be 34 degrees south, then if we look into the figure we may see that the *Cape* is near 11 degrees beyond the tropic of capricorn; and, we may suppose, has much the same influence of the sun, when it is in the tropic of capricorn, that *Gibraltar* has from the sun when it is in the tropic of cancer; for *Gibraltar* is in 36 north, as the *Cape* is in 34 south: their winters and summers are directly opposite, and that is chiefly what we have to regard in the management of the *Cape*-plants; we must give them what encouragement they have in the months *November*, *December*, *January*, and *February*; for the figure shews us that the sun is nearest to the *Cape* in those months, and indeed the plants themselves shew it us in their attempts of flowering at those seasons: but we must not suppose that all the plants, we receive from the *Cape*, are natives of that place; for there are many sorts of plants cultivated at the *Cape*, which are plants of other countries, so we must use some caution in this affair.

In the figure we may observe, that in the month of *May* the sun is just as near us as it is in *July*, and in *April* as it is in *August*, in *March* as in *September*; and yet though the sun is equidistant from us in *July* and *May*, we find that the heat of *July* is far superior to that of *May*, which I suppose happens because the sun has had more time to warm the earth on our side, and consequently the body of air; but I think I have said enough upon this head to render my scheme intelligible, and shall only add, that it is my wish, that every one who goes abroad to the countries where those extraordinary plants are, which I have mentioned,

would

would be industrious to bring them to us, that in due time they may be rendered useful. I cannot suppose, indeed, that a ship will put so far out of her way, upon her return from an eastern voyage, as to leave plants at any of our settlements in *America*; but let the plants be brought to *England*, there to be kept till a proper opportunity offers to send them to the places designed for them; the new stoves that are lately built will preserve them, if such instructions as these be followed, let them come from what latitude they will.

I remain, Your most humble servant,

R. BRADLEY.

CHAP. XVIII. *A method of meliorating orange-trees in England, so as to make them thrive and bear more profitable fruit than has yet ripened with us by the ordinary practice.*

THough we have several very fine orangeries in *England*, which produce abundance of fruit, yet as that fruit has not always the advantage of sufficient nourishment from the tree, and the tree is not without hazard of being curbed in its vigour by accidents, which often happen in the common way of practice, it may not be amiss to say something of planting orange-trees in the natural ground, without being subject to the inconveniences which too frequently attend those trees that are cultivated in tubs, pots or cases; such as chilling the roots, frequent occasions of stinting, want of the necessary quantity of water, having too much of it; while these that are planted in the natural ground are free in growth, and do not lose their vigour by stinting, nor are subject to any inconvenience or hazard but from the frost, which may

may be as well guarded against, as if they were to be set in a green-house.

The conservatory for these plants in the winter should be a kind of frame, which may be taken to pieces, and carried quite away in the summer: the expence of taking down and putting up such a regular frame as I mean, would not be equal to the expence of cases or pots, or even of the extraordinary attendance the trees would require if they were to grow in pots; and a frame of such a manner would be much less expenfive than some green-houses: besides, as the management of orange-trees in tubs or cases is almost as different as the minds of the gardeners who cultivate them; so if there should happen an occasion of changing a gardener, the plants in the natural ground would not be subject to suffer by a different treatment; but those orange-trees which are cultivated in tubs, are too frequently spoiled by the different practice of different men, as well indeed as most other things in a garden; so that it is to be wished a gardener would be constant in one business.

If we have a mind to cultivate orange-trees in the natural ground, we may as well plant them in walks, or in the parterre, as any other tree, only providing coverings for them of thatch, and four pannels of double straw-mattresses, or such materials to be fixed to a frame, as may keep their roots and shoots from the frost in winter: for in some parts of *Italy* and *France*, where the frosts are more severe for the time they last, than they are in *England*, such coverings or shelters as I mention are used with success, opening them now and then when the sun shines, and when there is no danger of the frosts hurting their roots. And we may be assured of this, that the trees planted in the natural ground will not so soon feel the frost, as those in tubs and cases; and an orange-tree will certainly, in this case, do well, if we only keep it from the frost.

While

While I am upon this head, I cannot help taking notice of a very ingenious contrivance for helping decayed orange-trees, of Mr *Philip Miller*, gardener to the company of apothecaries, at the physic-garden at *Chelfea*. His way of restoring decayed orange-trees, will add to our present delight in cultivating them, and also afford us some proofs of the advantages which these plants receive, when they draw their nourishment from a large fund of earth; which will appear to be much superior to that which trees can receive, when they are under the confinement of a pot or case.

Mr *Miller* tells me, that some orange-trees were once so disfigured by ill management, that they were judged by some unexperienced persons to be of little or no value; but he having observed in them a promising aspect, reasonably concluded, that though they had then none of the most gay appearance, yet they had virtue enough in them to be improved and become valuable with a little assistance; to this end, he thought it necessary to consult their natural mode of growth, and treat them, if possible, in their own way, as well with regard to the degree of heat, as the necessary liberty; for the first he prescribed a glass-case well exposed, in which he directed a hot-bed of tanners bark, such as I have mentioned under the head of the ananas, as ordered at *Richmond* by Mr *Telende*; he pruned their heads, washed and examined their roots, and laid them in water for a convenient time, to make good the loss they had sustained. When this was done he planted them in baskets of proper earth, and filled up the divisions between them with the same soil, which was a sure way of giving the roots due liberty of searching for their nourishment; for the baskets would admit of a close communication of the roots with the body of earth, which was laid between them, and that earth had no nourishing quality in it that the roots could not draw through the baskets; the consequence was, the trees for the most part

part made shoots of two feet, and some near three feet long the same summer, and produced blossoms. I had once a trial of the same kind, excepting only that my plants were in pots, and these were in baskets; but, I confess, though mine grew well, yet they were not so vigorous as Mr *Miller's*, for I suppose my trees wanted that fund of nourishment which gave the trees, he mentions, their excellence of shoot; but besides this advantage to the trees, the baskets they are planted in, if they are strong, will prevent any check at the time of moving such trees to another place, when otherwise they must have been haulted in their health and vigour (a).

C H A P.

(a) The best compost for orange-trees is two thirds of fresh earth from a good pasture, which should not be too light nor over stiff, but rather a hazle loam: this should be taken about ten inches deep with the sward, which should be mixed with the earth to rot, and one third of neats dung: these should be mixed together at least twelve months before it is used, observing to turn it over every month, to mix it well, and to rot the sward; this will also break the clods and cause the mould to be finer. Before you make use of this earth, you should pass it through a rough screen, to separate the great stones and the roots of the sward therefrom: but by no means sift the earth too fine; for this is very prejudicial to most plants, but particularly to orange-trees.

If the ground is wet, or of a strong clay, so as to detain the moisture, the borders should be raised above the level of the ground in proportion to the situation of the place, for where the wet lies in winter, near the surface, it will greatly prejudice, if not totally, destroy the trees, so that lime-rubbish should be laid at least two feet thick in the bottom of the border, to drain off the wet; and the earth should be laid two and a half or three feet thick thereon for the roots of the trees. *Miller.*



CHAP. XIX. *Of the improvement of flowers, in an account of the ranunculus raised from seeds by Mr William Potter, in a letter to J. S. Esq;*

S I R,

WHEN last I had the happiness of your company, you desired I would, as occasion offered, send you an account of such curiosities as occurred to me in the way of gardening; and I have now the good fortune of acquainting you with one of the most surprising productions of nature that I have ever met with, either at home or abroad, and, I doubt not, but it will be the more acceptable to you, as you are a lover of flowers.

I was lately at *Mitcham* in *Surry*, to view a collection of seedling ranunculus raised there by Mr *William Potter*, having often heard of their excellence from several of our best judges, who had seen them in the strength of their bloom. I confess, among all that I have ever seen of the ranunculus-kind, I have yet never met with any that were so agreeable to me, either in beauty of colours, variety of make, or largeness of blossom; and though there are many hundred distinct sorts of them, I am yet puzzled to say which of them pleased me best: there are many of them which have all the properties that we could expect in a good flower; and the others are so widely different from whatever has been seen in *England*, that they shine in such properties as my knowledge of flowers could never give me hopes of expecting.

Their colours are of all sorts, in several degrees, from the clearest white to the darkest purple, but the azure-blue is only wanting, to carry them through all the colours, to the deepest black. Some of these flowers are of one colour alone, others with their petals

petals or flower-leaves, striped with various colours which mark quite through, as the carnations do, which are called flakes. Some are powdered or pounced with the gayest colours, like the carnations called picketees. Others again are tinged on the edges with varieties of colours; and some have their centers stained with colours directly opposite to those of their other leaves.

As for the make or figure of these flowers, there are some shaped like the ranunculus, called the *Turk's* turbant, and such sorts as we have usually cultivated in our gardens, are extremely double, and blow very tall; others take the form of roses of several kinds, and have their flower-leaves of that shape, and disposed in that manner. Some again are shaped like the *African* marygold, and others like the *French* marygold, even resembling these in their colours. Some flower like double anemonies, and others like the finest double poppies, bringing blossoms as large as peonies. Some are of a star-like figure, and others turn their leaves back, so as to form the figure of a globe: and there are many of such odd figures, that I know not what to compare them with.

The greatest part of these flowers blow near two feet high, and branch liberally from the root; so that it is not rare for one root to bring near forty flower-buds to blossom with good strength: the manner of their growth, and bringing their blossoms, is much like that of the great yellow ranunculus of the meadows, which holds in flower near three months, and is very hardy.

Many of these are semi-doubles, which bear seeds that ripen well, and come out of the ground with little trouble; and some of them are extraordinary, for having their seed-bearing vessels of a bright yellow-colour: but it is an endless work to mention every remarkable difference in them; you should see them, to admire them enough.

Though

Though the original of these flowers came from *Persia*, I find the offspring are very hardy, and resist the frosts, even better than our old sort of *ranunculus*; and they will flourish any where, if the ground be rightly prepared for them.

The natural soil in *Mr Potter's* garden is pretty light, with a gravelly bottom; but his flower-beds are made with the following mixture, which he gives me leave to mention, that every one may have the same success that he has had, in blowing this sort of flower. It consists of rotten leaves, rotten wood, cow-dung, horse-dung, and some of the surface of the natural earth; which he gathers altogether by the side of a wood, into an heap, and sifts very fine for his beds, after it has lain together for some time. And when these are prepared, he plants his roots about *Michaelmas*, so as to bury the bud of the root about two inches and half deep. When they begin to come out of the ground, we may shelter them in frosty weather with mats; and, as they begin to rise, cover the bed with a fresh coat of the aforesaid earth, about half an inch thick, which will greatly strengthen the roots, and especially help the new forming roots or off-sets: but this must be done carefully, without injuring the leaves or their stalks; for every bruised or broken stalk injures the root, till the plants come to flower, and even then too, if the blossoms are frequently cropped. There is one reason in particular for the coating the beds with a little fresh earth, which is, that the *ranunculus-root* which is put into the ground, always produces its off-sets near an inch above it, and as they grow, the mother-root decays, and even these new roots help the good blossoming of the plant, because they join with the flower-stalk, and help to nourish it, as well as receive nourishment from it; and therefore this fresh earth helps both them and the flowers.

Now, when I consider that your soil is very strong and binding, I shall take the freedom to offer you a little advice from my own practice, in a soil which was so stiff, that it was judged fit for nothing but making of bricks, and even upon such a soil I had extraordinary success, in the culture of the ranunculus, though it is supposed by many, that a clay-country will not blow a ranunculus, or even suffer it to live, although the beds are prepared with proper soil. I confess, was the common method of preparing beds in such a soil to be followed, we must expect the roots to be destroyed, or to produce very weak flowers; for the usual way of making these beds, is to dig deep trenches in this clay-ground, and fill those trenches with good light sifted mould, which practice I find to be wrong; for if we once dig trenches in clay-ground, they serve only to receive and hold all the water that falls; so that the fine earth which is put into them becomes a perfect bog, this corrupts and chills the roots, although they are planted somewhat above where the surface of the clay reaches; besides this muddy and standing water at the bottom must have an unwholesome vapour rising from it; and the earth in the upper part of the bed, is kept so continually moist by the wet below, that a ranunculus cannot, by any means, endure it; and I have experienced, that the best drains that can be made from these sort of beds cut in clay, will not sufficiently drain them of the wet they receive, even though the ground lies upon a hanging level. I therefore find it advisable in such ground, only to take off the superficial soil which covers it, three or four inches deep, without entering the clay, and then to lay on a little coat of sea-coal ashes, or for want of them, some lime-rubbish, and upon any of these, to raise my bed about nine inches or a foot thick, with good prepared earth, such as I have mentioned above; or as I used to do, about

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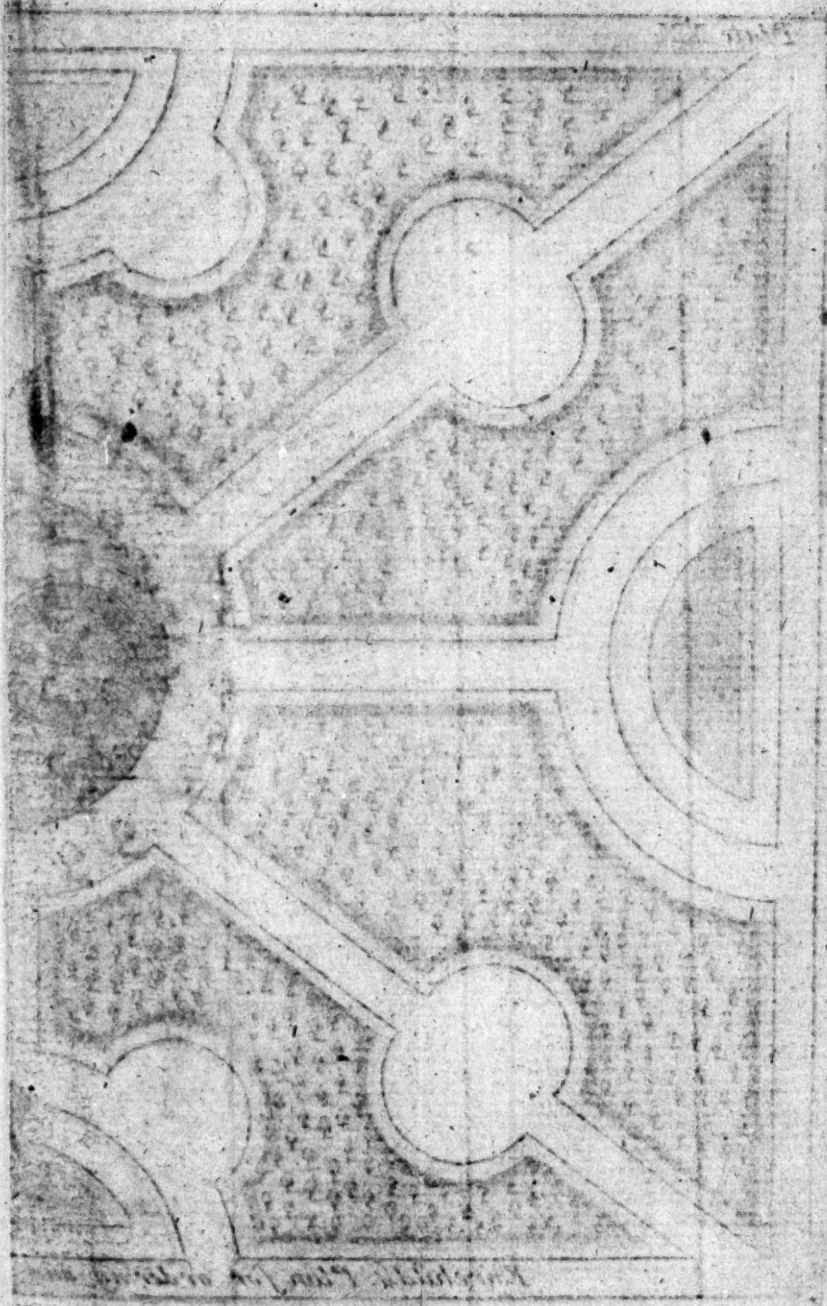
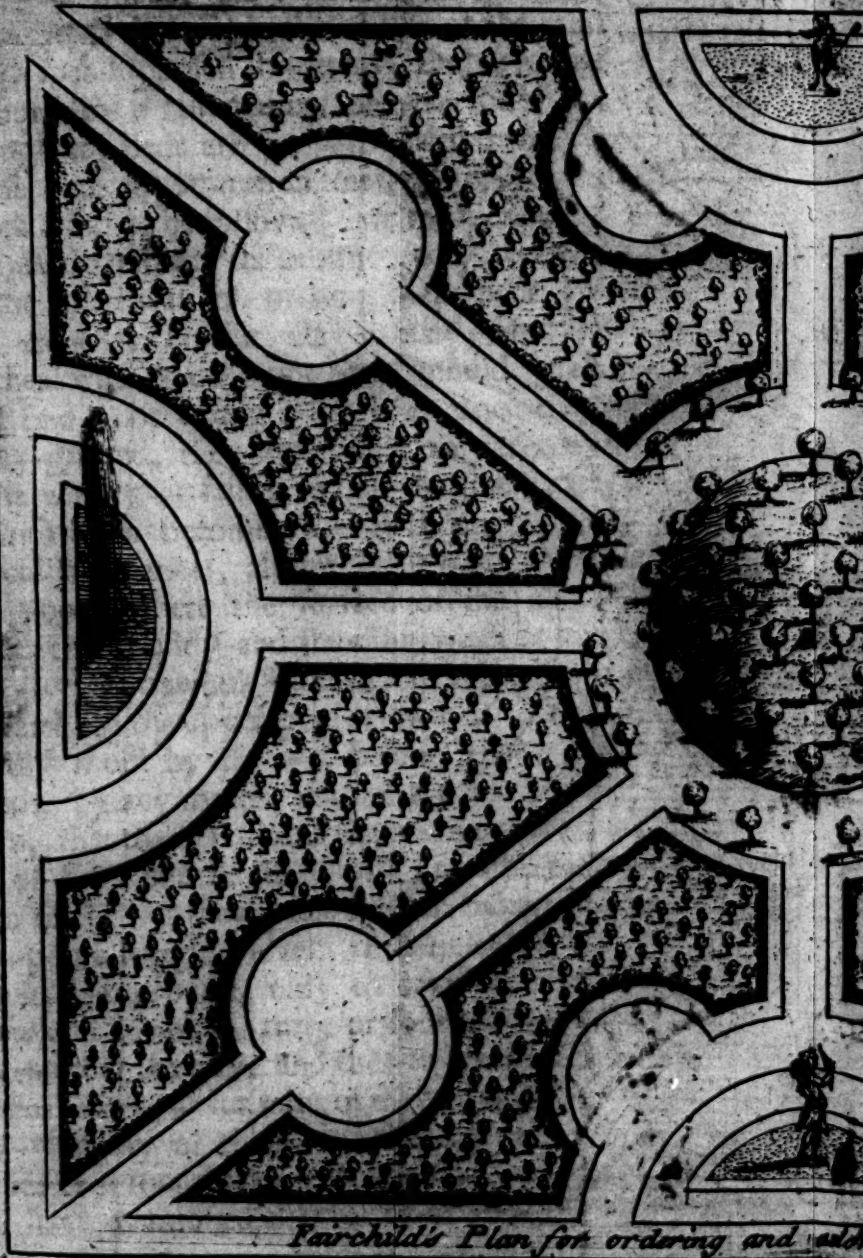
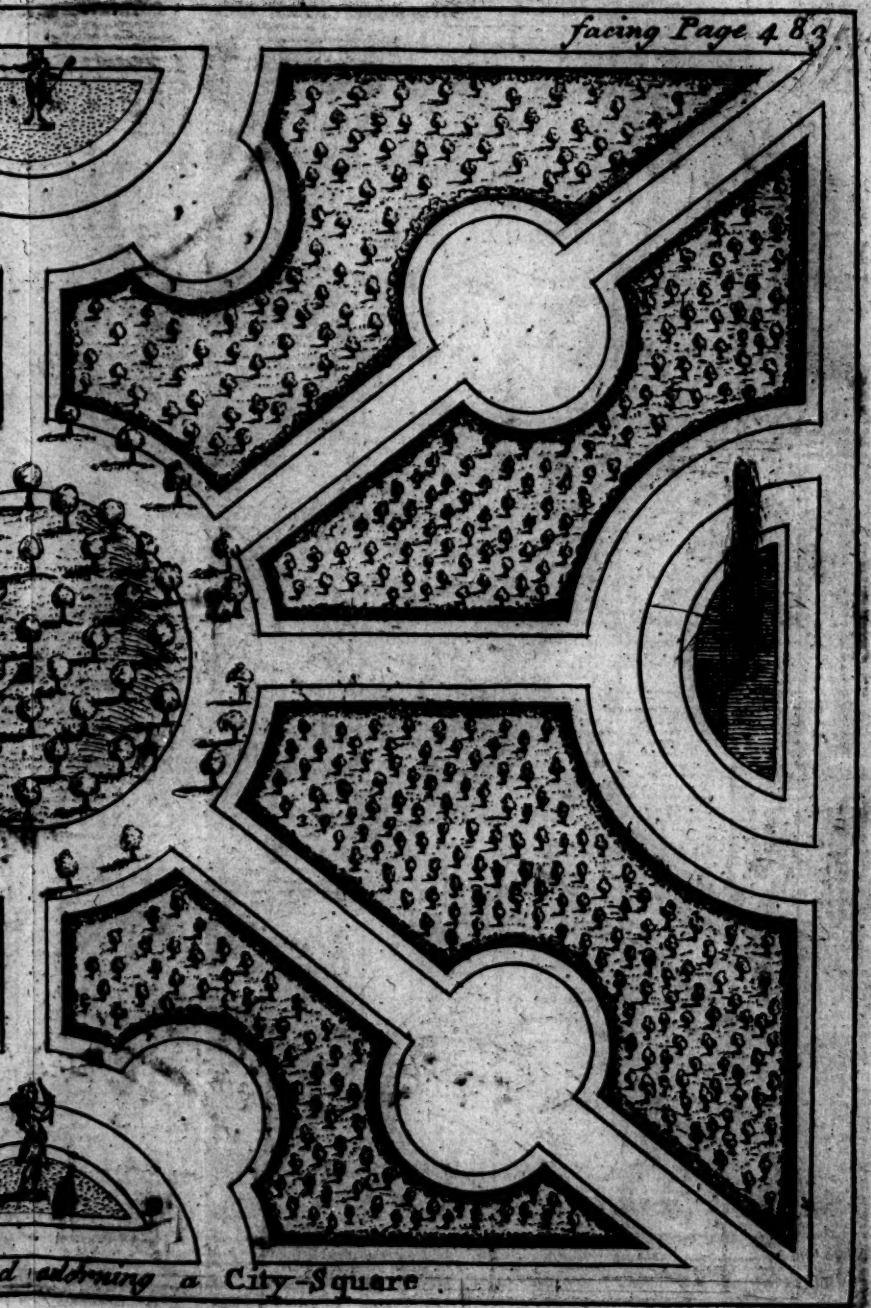


Plate XX

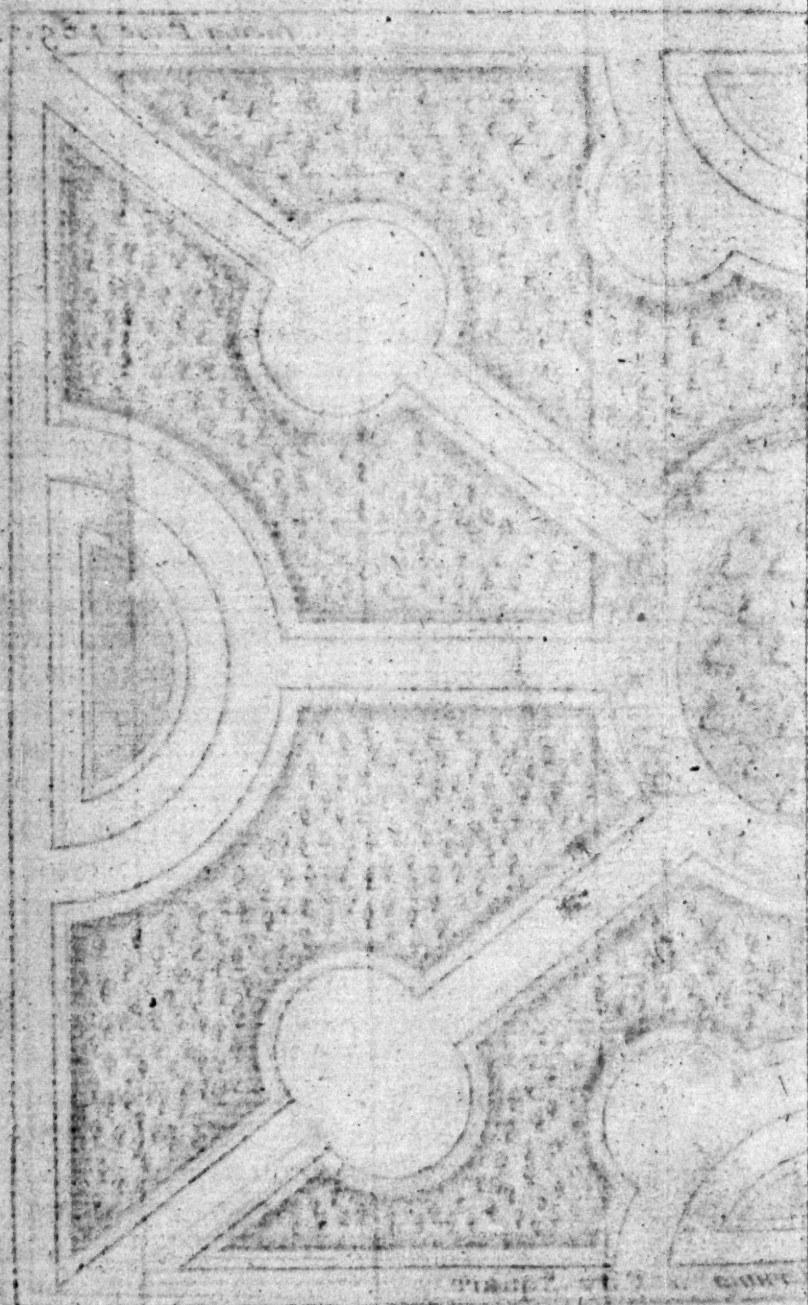


Fairchild's Plan for ordering and...

facing Page 483



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one third part sandy loam, as much old melon-earth, and the rest rotten wood and leaves; but these must be well mixed together, and sifted before we use them. But I have had very good success likewise in making my beds for the ranunculus of mould that I have taken out of great woods; I mean the parings of the surface, which has been chiefly rotten leaves and wood, that have lain there, I suppose, many years. The reason I chose that soil was, because I observed the common ranunculus called pilewort grew and prospered in it wonderfully: and a gardener at *Alton*, who made his ranunculus-beds of old tanners bark, had his ranunculus prosper so well in it, that he had seldom less than eight or ten roots increase, for every one he put into the ground.

I must observe likewise, that the paths or alleys between these beds should be filled up with sea-coal ashes, or lime, or brick-rubbish, or sea-sand, to draw the super-abundant moisture from the beds, and keep the ground about them as dry as may be; or else, if these are difficult to be had, we may lay the alleys with grass-turf, which will likewise help to keep the beds dry in the winter, as the ranunculus requires. The raising the beds thus upon the top of the clay, will suffer the wet that falls to pass away without incommoding the plants, and you may then expect a good shew of flowers. I have known this kind of flower blow extremely well under a south wall (a).

I am, Sir, Yours, &c.

R. BRADLEY.

(a) The beds in which the *Persian* ranunculus-roots are planted, should be made with fresh, light, sandy earth, at least three feet deep: the best soil for them may be composed in this manner; viz. take a quantity of fresh earth from a rich upland pasture, about six inches deep, together with green sward; this should be laid in an heap to rot, for twelve months before it is mixed, observing to turn it very often, to sweeten it and break the clods. To this you should add

CHAP. XX. *Sixty-six observations and experiments concerning manuring, planting, grafting, and pruning of trees, with the best method of gathering and preserving the fruit. By J. M. Esq;*

THOUGH we frequently meet with good instructions concerning the culture of fruit-trees, yet it is observable, that every day produces some improving discovery among the curious. In the time of

a fourth part of very rotten neats dung, and a proportionable quantity of sea or drift-sand, according as the earth is lighter or stiffer: if it be light and inclining to a sand, there should be no sand added; but if it be an hazle-loam, one load of sand will be sufficient for eight loads of earth: but if the earth is strong and heavy, the sand should be added in a greater proportion: this should be mixed six or eight months before it is used, and you should often turn it over, in order to unite the parts well together, before it is put into beds.

This compost should be below the surface in the beds, in proportion to the driness or moisture of the place where they are situated, which in dry ground should be two feet eight inches below the surface, and the beds raised four inches above: but in a moist place they should be two feet four inches below, and eight above the ground; and in this case, it will be very proper to lay some rubbish and stones in the bottom of each bed, to drain off the moisture, and if upon this at the bottom of the beds some very rotten neats dung is laid two or three inches thick: the roots will reach this in the spring, and the flowers will be the fairer: this earth I would by no means advise to be screened very fine, only in turning it over each time, you should be careful to break the clods and throw out all large stones, which will be sufficient.

The beds being thus prepared should lie a fortnight before the roots are planted, that there may be no danger of the earth settling unequally after they are planted, which would prejudice the roots by having hollow places in some parts of the

of my practice I have picked up the following remarks, which, I think, will be of service to every one who is a lover of good fruit.

Observation I. If any branch in the middle of the tree rises with too much luxuriance above the rest, in full sappy wood, we should cut it off close to the body of the tree, but with great caution, lest we injure the bark of the great wood we take it from; for such a wound would endanger the health of the tree, as the wounded part would be a long time recovering, and be subject to canker.

Obs. II. We likewise must observe, that trees should be pruned but once a year, which I know is very contrary to common practice; for there are too many people who are never without their knife in their hand; the continual pruning makes a tree shoot into false wood, and miscarry of those buds designed for fruit; it interrupts the free passage of the sap to such buds, by diverting it to support the wounded parts of the tree, and so we lose the benefit which would arise from the preparing buds for blossom, which otherwise might have been fruitful the succeeding year. The reason why trees shoot more in wood when they have been largely pruned, than they did before, is because the root had filled itself with juices proportionable to the nourishment its standing branches required; but when many of them are cut away, the same fund of radical

the bed to which the water would run, and lodge, and so rot the roots in such places. Then having levelled the earth, laying the surface a little rounding, you should mark out the rows, by a line at about six inches distance each way, so that the roots may be planted every way in straight lines: then you should open the earth with your fingers at each cross, where the roots are to be planted about two inches deep, placing the roots exactly in the middle, with their crown upright: then with the head of a rake you should draw the head upon the surface of the bed level, whereby the tops of the roots will be an inch covered with earth, which will be sufficient at first. *Miller.*

radical juice goes to the nourishment of the remaining buds, that otherwise was designed to nourish as many more, perhaps: so that then we may suppose, if the balance was equal between the buds cut off, and those remaining upon the tree, the remaining buds might just produce the same weight of wood, that the shoots of that year would have done, had the tree not been pruned.

Obs. III. When a tree is in good order, we must take care not to prune it too close, or take away too much wood within-side, as some are apt to do, who leave a dwarf sometimes naked within: it is however necessary to allow air between the shoots which come from the middle, in proper places, for the better admittance of the sun to ripen the fruit; and in this case let us remark, that we may allow the shoots of a dwarf-tree more air in a strong wet ground than in a light sandy one, which by its natural warmth, gives colour and taste to those fruits, that in wet cold ground would be insipid and good for nothing.

Obs. IV. Winter-fruits should have their shoots left wider asunder than the summer-fruits: the latter not wanting the sun so much as the others do, therefore may be left pretty full of wood. We may likewise remark, in the pruning of trees, that such as have made weak shoots should be pruned betimes, the latest in *January*; for pruning draws the sap: but those trees which are very vigorous should be pruned late in the year, *i. e.* in *April*, or even in *May*, as they will bring less wood and more fruit.

Obs. V. We must consider the climate where we live, that we may direct our practice according to the degree of cold or heat; in hot countries the fruit must be gathered sooner than in the colder climates, because the sap has performed its work sooner; and on the contrary, in cold climates the fruit must hang longer upon the tree to ripen; by which means it will keep longer: for with me it is a constant rule, that the longer fruit
can

can draw the sap, the longer it will last; and it is the same in nature, when we speak of pruning, or of a plant, or the culture of trees, which we would forward or retard: we should gather fruit after a frost, for then we are sure the sap does not help them.

Obs. VI. The gathering fruits should be done with a great deal of discretion and patience, taking care that we do not destroy the blossom-buds which are near it, or are joined to it; for the buds are framed for the fruit of the next year when we gather our fruit. Apples are much harder to gather than pears, being more closely fastened to the tree, and their stalks much shorter than the stalks of pears.

Obs. VII. In hot dry years, if the season is hot about autumn, our fruits should be gathered about the beginning of *October*, rather than left upon the tree till the end of the month; for such fruit as has had a large share of ripening upon the tree, lasts but little, and is very subject to rot; but if *August* and *September* be wet and cold, then let the fruit hang upon the trees till the end of *October*, and it will keep well. This I account one of the most material observations relating to fruit, though few gardeners make any account of it. We must be likewise careful to know our sorts, that we may not lose them in their season, and without occasion suspect our fruit-keepers; but without an exact catalogue of our fruits and seasons we cannot do this; and I think therefore, if the name of every fruit was written upon some board placed over every tree in a garden, and the time marked of its ripening, one might be very easy on this score, as it would prevent any one that can read, from gathering a fruit before its time; which is too frequently done in gardens, to the displeasure of the master, and the distaste of the gatherer.

Obs. VIII. When a tree is full-set with fruit, and we rather covet such as are fair and good, than a large number of such as are indifferent, we may with a pair

of sharp scissars cut off those which are most weak and sickly about the middle of their stalks, which will prevent the weeping or loss of the sap: and if the tree in its first or second sap tends to shoot abundance of false wood, it must be pinched off while it is tender, but never cut while the sap is flowing; for by cutting the tree then it would run into wood, and the blossom-buds, which the second sap would fill, would thereby miscarry. The blossom-buds, I speak of, are formed by the first sap, viz. between *April* and *June*, and are filled by the second sap, between *July* and the beginning of *October*, for opening and bearing the following year.

Obs. IX. Before we prune our trees, we must consider their strength, and in proportion to that, we must cut them into shape, as well as for bringing good fruit. It is an opinion still prevailing among some people, that if trees are weak, they must be cut in the increase of the moon, to make them give us stronger wood; and when they are very strong, they must be cut in the time of the moon's decrease, to make them bring abundance of fruit and less wood: but let every one use his own judgment in this case.

Obs. X. We find that some trees are more apt to shoot into wood-branches than others; when we meet with such strong shooting trees, we must prune so as to leave the shoots long; and according to their strength, let their shoots remain longer or shorter; but those shoots which have blossom-buds upon them in any great quantity must be shortened, that the remaining buds may nourish their fruit the better, and the tree make good wood.

Obs. XI. It is necessary in the first or second year after the tree is planted to prune very short, to make it shoot or sling into wood; and if in the succeeding years it does not happen to come into a bearing way, but still keeps shooting strong and unprofitable branches, as is common with the rousset, the bergamotte,

gamotte, the virgouleuse, and some others; then if we prune at all, let us leave every shoot very long; or rather leave such trees without pruning, for then the tree will certainly set to bearing, and the sap will not spend itself to no purpose; but when those long branches are knotted with blossoming buds, we may break off a convenient number of them, according as those branches are more or less in strength. Of all the sorts of pears, there is not one which will bear pruning so short as the winter bon chretien; for then it will give large wood, and upon that we may expect large fruit.

Obs. XII. About *May* we should begin to top and pinch off the useless or too vigorous buds of trees, especially such as are in espalier, or against walls; for then the useful shoots will be better nourished.

Obs. XIII. When we prune a dwarf-tree, we must take care that its shoots and branches on every side be rightly balanced, and as equal as can be, lest the winds have power enough over it to strain the roots, or overset it.

Obs. XIV. We must likewise take care in the pruning of dwarf-trees, not to leave any branches or shoots too near the ground; for whatever fruit comes upon them, has little taste, and quickly rots.

Obs. XV. In pruning trees we must have regard to the soil and climate; if it be wet and cold, the fruit is green and less in its colour, and consequently is not so well flavoured: in this case the shoots of a tree must be pruned free and open, that the rays of the sun may pass freely between them; but in light sandy grounds, where fruit is always good, though it is smaller than in the former lands, the pruning is very different; it should be very little or not at all in pear-trees; for in very hot dry land, the wounds made by pruning recover with difficulty, and in the driest lands, I have sometimes known pear-trees perish entirely by over-pruning.

Obs.

Obs. XVI. When a tree looks yellow, pluck it up, without troubling yourself to prune or amend it with any extraordinary culture; for though it may keep alive for two or three years by judicious management, it will then be fit for no use; and if we had pulled it up at first, and planted a fresh tree in its room, we might have had good hopes of fruit. But if the sick tree is of a scarce or rare kind, and it is worth looking after, we may lay about the roots mud that has been well turned and aired, so that it is become good mould, which may recover its strength; or else hog's dung may be used in the same way; this enlivens such roots as have been too much burnt and scorched by horse-dung.

Obs. XVII. If we find that pears upon quince-stocks do not thrive in the place where we have planted them, we must change them for free-stocks; and if those should grow yellow, we may try apples in their room; and if we have not then hit upon the humour of the soil, we must try other sorts of fruit, till we find what will best prosper in it; for unless the tree and the soil agree, all our planting and pruning is to no purpose.

Obs. XVIII. The pear-tree likes to be planted shallow, especially in such lands as have gravelly or stony bottoms; in such cases we must plant upon the surface, that the roots may spread. In great heats we may lay fern or straw over the roots of pear-trees, which will help the tree extremely in its shooting.

Obs. XIX. When we make our plantation, shorten the downright roots of the trees, that the remaining roots may spread rather than shoot downwards. If the tree is young, we may leave the top root longer, than if it was five or six years old.

Obs. XX. Every curious person in fruit, should always keep by him a good number of free-stocks to help his plantation with; but such a nursery should

be

be raised from kernels: the suckers taken from about the roots of trees are good for nothing.

Obs. XXI. We should likewise provide a nursery of quince-stocks, which are best raised from that sort of quince whose wood is the brownest, the leaves large and round, and velvety on the back. This kind brings the strongest plants, contrary to that which is called the male quince; which one may easily distinguish in the nursery, by its languishing appearance, and small shoots. Its sap is always more sour than the others; and if one was to graft upon such plants, the grafts will hardly hold; the best way is to pull them up, and plant others in their place.

Obs. XXII. When we graft a young or old tree where fruit was not agreeable, we must graft it upon every arm or branch as equally as possible; for if we were to leave some of them ungrafted, they would draw away the greatest part of the sap, and rob the grafts, I mean such as are grafted in the cleft; for budding or inoculating a tree does it no harm; but a bud will shoot and thrive as well as any other part of a tree.

Obs. XXIII. When our nurseries are compleat, we must take all possible care, when we are about transplanting our trees, either for standards, dwarfs, or espaliers, that the roots are not injured by taking up; the holes for these trees must be made as large as possible, and the ends of the roots cut very smooth, which will dispose the tree to shoot the better; let none of the small fibres remain, for they are apt to rot and infect the great roots.

Obs. XXIV. When we plant a free-stock, quince-stock, or other wilding in any place, to be grafted the following year, take the same care as you would do in planting the finest fruit. I know this has been often neglected, though it is the foundation of our work; and when it has not been regarded as it ought, the whole design has suffered.

Obs.

Obs. XXV. When we transplant any tree, we must observe to plant that side towards the south, which stood before to the south; and we must do what we can to defend the wound made by grafting from the violence of the sun.

Obs. XXVI. In dry sandy ground plant trees in autumn, and in moist and watery places plant in the spring; for otherwise the water, lying about their roots all the winter, would chill and destroy them, especially such as make tender wood, as plums, cherries and peaches. The pear and apple are more hardy in their wood, but yet more subject to be destroyed by water. It is good in moist grounds to open the holes for trees the beginning of winter, and so let them remain till spring before we plant, for the frost will mellow and enrich the soil taken out of them, and prepare it for spring-planting. Where the soil is light and sandy, and not subject to inundation, plant your trees about the beginning of *November*, and they will gain fibres enough to support them before the frosts begin, and will shoot with reasonable strength the spring following, and with much more freedom than those trees which are planted that spring. Observe also, that all trees grafted upon free-stocks must be planted in light dry grounds, and the grafts upon quince-stocks in strong wet grounds.

Obs. XXVII. Graft those pears which have a beuree, or melting flesh, upon quince-stocks, but seldom or never use a quince-stock for the dry flesh-pears; for the juice of the quince, which is harsh, dry and rough, adds to the driness of those fruits grafted upon it; but the share of that driness, which the grafts of the melting pears can take from the quince-stock, helps such fruit in its keeping; for all fruits which are grafted, are influenced in some measure by the juices of the stocks they are grafted upon.

Obs. XXVIII. In grafting upon quince-stocks, we may observe, that the *Portugal* quince is preferable

able to any other kind; its sap is strong, and the grafts upon it bring large fruit: this sort of quince has a fair tender fruit, which, in a good year, may be eaten raw.

Obs. XXIX. I have remarked, in the way of grafting, a curiosity, which it is likely may be still new among many professors of gardening, and, I am persuaded, it will give them satisfaction. For example, if we have a good bearing pear-tree, which runs so much to blossom, that the shoots and fruit are small; then if we take from the bearing shoots of such a tree a few buds, and inoculate them upon large vigorous shoots of some other pear-tree, such buds will bear the second year, and produce very large fruit, having plenty of sap to nourish it; or if we put buds of the less bearing kinds upon good bearers, such buds will so far be over-ruled by the nature of the bearing tree, as to bring abundance of fruit: but on either of these occasions, it is necessary to assort our fruits, and inoculate only summer-pears upon some of the pear-trees of the same season. Autumn-pears should be inoculated upon autumn-pears, and so on; but never bud, or graft a winter-pear upon a summer-pear, for the sap of the summer-pear-tree will decline before the winter-fruit can come to its full growth.

Obs. XXX. However the inoculating of old trees may serve for a few years, we ought to use the earliest means to interplant them with young trees, of those which we like best, that they may be in a forward way of bearing, as the old trees decay; for a tree will make us wait its own time before it comes to bearing; and if we let this work alone till our old trees are quite decayed, we must have a great deal of patience before our loss be recovered.

Obs. XXXI. All peaches raised from the stone are so generous to the climate where they are raised, that their fruit ripens well while they are cultivated in that

that climate. Some indeed may be worse in their nature than others, but the good may be preserved, and the bad flung away; and, I think, it would be of great use to our gardens, to fling out all the indifferent kinds of fruit, that they may not rob us of good ground. I would have our catalogues abridged, for, like great societies, there are ten bad peach-trees for one which brings good fruit. Peaches thus raised from stones hate a knife, and it is no matter how little any peach is pruned: the standards bring more pleasant fruit than peaches against walls, because, as I suppose, the sun takes them on all sides; and then standards are not so much under the discipline of the knife, as the wall-trees, and therefore they are more free from insects, curled leaves, weak shoots, blights (though more exposed to the winds) or loose branches. The free growing trees are always healthful, but those that undergo the severity of pruning, either languish, or shoot to no purpose. The standards also bring their fruit later than the wall-trees, and furnish us with benefits when our walls are vacant, but if there is any occasion of pruning the standard stone fruit-trees, it is only in case they rise too high, and then they should be lopped as we do willows, in which case they will send out large wood, which will soon bring good fruit, even the second year. Upon the lopping such trees, the wounds should be immediately plastered with some preparation of wax, tallow, &c. to prevent the gum; but the cutting of the great wood does not incline the tree so much to gum, as wounding the little wood.

Obs. XXXII. As the peach is one of the most delicate trees of our garden, it must be diligently cultivated, and we must consult its soil, which for the good of the fruit should rather be light than strong, and more dry than wet; the wet strong soil will indeed give large fruit, but then it is watery and insipid; and

and the light dry soil, though the fruit is not so large, yet is better coloured and better flavoured.

Obs. XXXIII. The peach chiefly loves the morning or the noon sun, as the fruit is disposed to ripen more early or late, and those which will bear in standard or dwarfs should not be too rudely exposed, but have some shelter, otherwise our expectations will be haulted, for the tree is very subject to suffer by the wind.

Obs. XXXIV. A peach may either be grafted upon the almond or the plum; and it would be well to consider the nature of our soil before we chuse which stock to graft on; for the almond loves a strong land a little wet, and the plum chuses a drier and higher soil.

Obs. XXXV. We should set the sweet almond to raise stocks from, laying the almonds about *Christmas* in dry sand to sprout; and the *March* following, or in *April*, according to the softness of the season, we may plant them at a foot distance in the open ground; and if the sprout or radicle be then too long, it may be pinched short, as our judgment shall direct, and about *September* in the same year, they may be inoculated in a dry time, observing, that the bud be taken from a strong shoot of a peach, that has three leaves growing at it.

Obs. XXXVI. All buds will take better the first year upon the almond than the second or third year, because the stocks of the first year are not so subject to gum, as those that are older.

Obs. XXXVII. If the almond-stocks are large that one would graft or inoculate upon, it should be done at the time of the second shoot or midsummer shoot, that the bud may sprout immediately, and not be suffocated by the gum, which too often attends a wound made when the tree is in its full sap.

Obs. XXXVIII. There is a sort of tender almond which comes from *Genoa*, that is yet better to inoculate

ate peaches upon than the sweet almond before-mentioned; these almonds should not be laid to sprout, but put into the ground in the spring; they shoot vigorously, and make a handsome plant in a summer.

Obs. XXXIX. As almonds will not easily bear transplanting without extraordinary care, I would advise, that we set them in such places in the nut where we design them to grow, and inoculate them there, without running the hazard of transplanting.

Obs. XL. The bitter almond is by no means good to inoculate peaches upon, though that sort is more hardy, and will transplant better than the sweet almond.

Obs. XLI. The pruning of peaches ought not to be till the blossoms are so much swelled, that we can discover the bearing from the false blossoms; which in some trees may be done at the end of *February*, and in others not till *March*. *Note*, What our author calls a false blossom, is a male-blossom; which, from good observation, proves to be differently made from those blossoms which bring the fruit. Our author says, that we should defer pruning, till we can discover which blossoms are male, and which otherwise; for, says he, the false blossoms never bear fruit, and therefore should be cut off; but there was little of the generation of plants known when he made his memorandums. I conceive, they are as necessary to be left upon the tree as the others, and are of use to make the tree bear as well as the false blossoms of cucumbers, melons, gourds, &c. but, however, I think it necessary to delay pruning of peach-trees which are tender, till the sun has gained a little strength, for they are too apt to shoot vigorously, and late pruning prevents their over luxuriance; should we prune them when the frosts have any force, they would be endangered.

Obs. XLII. We may top the bearing branches, or prune them according to their strength, which is the way to have good wood and good fruit; the strongest

strongest shoots may be left a foot long, or more, and from thence we may expect good wood to fill our wall: this a peach-tree often wants, which should, as much as possible, be filled up with young shoots, for it is them alone that bear fruit. When a shoot is of a middle size, it is commonly furnished with fruit-buds: then it should, according to its strength, be shortened; and the smallest shoots, which have blossom-buds upon them should also be cut to a convenient length, that the fruit may be large, for one or two good fruit is worth five or six which have had ill nourishment.

Obs. XLIII. After the spring-pruning of peaches, the trees must not be touched with a knife all the year, excepting such shoots as cannot conveniently be laid to the wall; the spring-pruning being as much as a peach-tree can suffer, without declining in its health. I cannot by any means agree with those who cut down these trees that are nursed against walls once in four or five years, to make them renew their wood. A tree ought to fill the part of the wall allotted for it, and it is the fault of the master if it does not, unless the distemper lies at the root.

Obs. XLIV. If close pruning be at all allowable, it is during the first two or three years after planting, that the bottom of the wall may be well furnished; and though this pruning be often practised, yet it is not every where that we find the effect it ought to have; for too many lead the shoots upright, which should be spread horizontally, and, by that means, leave the wall naked at bottom; and, in a few years, they tell us, the wall is too low for the tree: this is a very great fault. In this first pruning, some are so favourable as to spare the branches which have blossoms upon them; but it is an unreasonable practice, for we never have a good and lasting tree that is suffered to bear so early.

Obs. XLV. The best stocks to be put in nursery for grafting plums upon, are the off sets of the black damask, and the St Julian, whose sap is sweeter than that of other plum-trees, which is commonly too sharp for grafts to take upon; the grafts, I mean, are in the cleft, and not in the bud, as some might conjecture.

Obs. XLVI. The St Julian plum is indeed the surest for budding upon, and the fruit grafted upon it is more melting than that grafted upon other stocks; the black damask has a drier juice, and therefore the bud is not so proper for it.

Obs. XLVII. Plums require a soil rather dry than wet, or more inclining to sand than clay. A black sand is the best of all for them; they bear sooner and better, and bring their fruit extremely well tasted.

Obs. XLVIII. We may cultivate plums either in standards, dwarfs, or against walls; the blue perdigon should always have a wall to prevent the shedding of its fruit, which it is very subject to do in the free air. This plum loves the rising sun, rather than the sun at full south; for the latter dries the fruit too much, and makes it fall as soon as it is set.

Obs. XLIX. In pruning of plums, we must have great regard to their strength or weakness; and as that is, we should leave more or less wood upon them; the large shoots must be left of a good length, and the middle size shoots must be left almost entire, that the tree may bring fruit soon; especially we should leave the shoots of plum-trees very long in a stiff heavy soil, where they are apt to shoot too much and bear little; in that case pruning close would make them shoot in a rambling manner, or subject them to distempers. Prune a plum as little as may be in a clay, or wet soil; wound those fruits which are inclined to gum as little as possible, among which is the plum, which

which is very subject to canker, and thereby distemper its whole sap.

Obs. L. As to standard plums, we should let them shoot at their pleasure, only minding to take away the false wood and the suckers from them; the false wood may be distinguished from the rest by its being long, thin, and of a greenish colour.

Obs. LI. When plum-trees begin to decay and lose their shoots, we must cut them down a little above the graft; in which case they will re-spring with strength, and bring us fruit the second year.

Obs. LII. Where we have to deal with wildings in this case, such as the damask, St Catherine, Rochecorbon, &c. we may leave a few of the suckers about their roots, but not too many, lest we ruin the old root; for every one of these suckers draw from it, and impoverish it, till at length it is quite starved.

Obs. LIII. When we have strong ground, which subjects some of our plums to run into wood, I would advise, that such as will do without walls should be twisted about a set of poles, such as I have mentioned before for pears, for the bending their shoots will check the sap, and bring them to fruit-bearing without pruning; and then they will not be subject to gum or spoil (a).

Obs. LIV. A cherry requires a light sandy ground, which brings it to bearing sooner, and makes it yield better fruit, and in greater abundance than it would do in stiff land; at the same time, we do not say, that this fruit will not bear at all in wet or heavy ground, but where that happens, it is the most subject to drop its fruit.

Obs. LV. If we are inclined to have dwarf cherry-trees, we should not by any means graft them upon

(a) See Part II. Chap. 3.

the wild black cherry, but upon cherries which are already grafted, chiefly the morello; for the black cherry is too strong a shooter, and the morello, which is a wild kind, though we cultivate it by grafting, brings its shoots with less vigour, and bears sooner and closer to the ground; but for standard trees, the black cherry makes the best stocks for grafting, and brings its fruit larger and better.

Obs. LVI. We may graft cherries in the cleft, or inoculate them, but the last way is much the best, when the trees are in their midsummer-shoot, and then we are not in much danger of being injured by the gum; but for grafting in the cleft, we must do that early in the spring, that is, about *February*, or at the latest a few days in *March*; it must be done before the sap rises, or else our grafting is to little purpose.

Obs. LVII. Some have experimentally found, that a cherry does better grafted in autumn than in the spring, and chiefly if we set our graft near the ground; the graft then takes immediately, and is so fixed, that the following spring it shoots with extraordinary vigour, abundantly surpassing those that are grafted in *February* or *March*.

Obs. LVIII. We shall leave the apricots commonly inserted in our *English* catalogues, and mention only two sorts, which are very remarkable now in *France*. There is an apricot all white without and within, which parts freely from the stone, and is well flavoured; about *Paris*, the eastern aspect is better for it than the southern sun; the stone is very small, and the fruit is almost as forward as what is called the masculine apricot in the *English* catalogues, especially in dry sandy ground.

Obs. LIX. What is meant by a male peach, a male plum, or a male apricot, are such fruits as do not quit the stone easily.

Obs.

Obs. LX. In *France* there is an apricot much esteemed, whose flesh is yellow, and the outside redder than the others; it is said to be one of the males, because it does not leave the stone, the shell of the nut always adhering to the flesh of the fruit; the juice is extremely good, and the kernel is as delicious as the sweet almond.

Obs. LXI. If we would have large apricots, and a great deal of fruit, we should cut them down from time to time, whether they are against walls, in dwarfs, or in standards, for they are very ungovernable; their shoots are commonly more vigorous than any others, except those of the vine; and when they are against a wall, or in a dwarf, we are necessitated to prune them, or else they outgrow their compass: but I find by experience, that pruning of such wood has the same effect upon apricots, as it has upon plums; and therefore, what can be properly left growing should be spared till we cut down the tree quite; but we are sure of this, that the apricot will shoot three times more vigorously in a clay, than it will do in a dry sand; I think a black sand or heathy ground the best for it; it will bear plenty of good fruit there, and make smaller shoots than in stiff land; and therefore requires less pruning, and will live in better health.

Obs. LXII. An apricot may be grafted upon a plum-stock, or a stock raised from an apricot-stone; the last, I think, is the best, because it is not subject to sling out suckers from the root.

Obs. LXIII. If we are disposed to bring our apricots sooner by a fortnight than they usually ripen, we must graft them upon almond-stocks; or to keep them more backward in their ripening, we may put them against north-walls; but those which are exposed to the north are not so well coloured as them which have other exposure as the north exposure

exposure brings the tree later into sap than others, the blossoms are in less danger from the frosts of the spring. I have observed, that those apricots, upon a north wall, bring their blossoms about three weeks later than the trees that are exposed to the south sun.

Obs. LXIV. The syrup made of apricots, being well mixt with water, makes an excellent refreshing drink.

Obs. LXV. Is concerning a cherry-tree which was made to bear fruit in autumn, as I have been informed by a person of credit, who told me, that in the west of *England* there was a large cherry-tree growing in a farm-yard, which was so little regarded by the owner, that when it was in full bloom, that is, in *April*, he suffered the boys to pick off the blossoms, to make garlands against some wake or fair which then happened in the country, and, to his great surprize, towards *August* the tree put out fresh blossoms; and the *October* following was full of fruit, which, he supposes, happened from the check that was given to nature in the foregoing spring, in pulling off the flowers; by which means he judges, that the first intent of the tree being stopped before the juices had spent themselves in the fruit or flower, the tree became then of sufficient strength to perfect its design in a second essay; and to act in autumn, even with more vigour than it would have done in the spring.

I have practised the same designedly upon raspberries and strawberries, and find, they will bring autumn fruit to perfect ripeness; and have had more than once the morello cherry ripened with me about *November*; which, I suppose, came from some check of the like nature, either where the spring blossoms had been broken off, or had been destroyed by a blight: nor is it uncommon for pears to blossom about

about midsummer, and set their fruit, but they seldom come to perfection.

Obs. LXVI. The vines of the *Canary* grape will now and then put out second bunches of blossom about *August*, but in the natural ground in our climate they come to nothing. I believe, nevertheless, with the help of artificial heat, they might be brought forward; for, I suppose, it is natural for this vine to bear fruit twice a year in the hotter climes, as I am told some do in the south parts of *Italy*.



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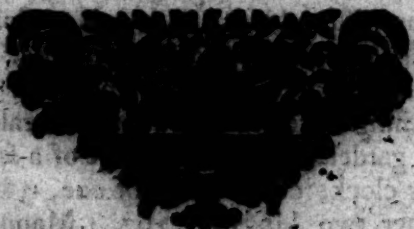
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